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S. Joseph

WHAT ARE WE?

AN ATTEMPT AT AN INTELLIGIBLE EXPOSITION OF THE UNIVERSE AND THE PLACE WE TAKE THEREIN

BY

LEONARD JOSEPH, A.M.I.E.E.

ILLUSTRATED

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ENTERED AT STATIONERS' HALL.

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WARNING

This work is not intended for juveniles, with the exception of *de facto* advanced students of theology, medicine, philosophy, or of the natural sciences generally.

~~1908505~~

PREFACE.

"Evil is wrought by want of thought
As well as want of heart."

I TRUST the generous reader will forgive my candour when I tell him that this work was drawn up on a rough frame to satisfy myself alone. Its writing was started for two purposes. Firstly, after manifold mental vicissitudes, I had arrived at a point which I considered to be the summit of one of the peaks in the region of thought, and I sought to describe what I saw in order the better to commit the same to memory; and in the second place, I endeavoured, by mapping out my former rambling thoughts on paper, to be the better able to cope with the many startling and perplexing controversies which at the present time are engaging alike the minds of theologian, scientist, philosopher, and the laity. Afterthoughts have convinced me that the goal I have reached, after many years' wandering, may be well worthy a visit from another than myself. Perchance some may stay there, very many more make it the starting-point for making travels of discovery into the vasts of conception.

This work must not, however, be considered as in any way exhaustive. It makes no pretension to the completeness of a pandect. It is the map of a continent, not of a country. No one point has been treated finitely to its logical conclusion, all details having been left for future occasions. On account of the complexity of the ways and the long distances traversed, reference has often had to be made to things already alluded to at a place nearer the starting-point, in order that, by each logical prominence *en route*, the other phases of the landscape left behind may remain fresh in the mind's eye, so as to obtain, on the part of the reader, a correct general idea of the entire journey.

This at least has been essayed, but the book itself is, I fear, nevertheless only a finger-post, that is all.

And now just a word before I lay open my map before you.

It would not be grateful of me, did I omit from this preface a few expressions of heartfelt thanks to all those who have been most kind and polite in supplying me either with scientific data, information and the results of their own research work, or who have helped me with their advice as to how to obtain the same.

In this category I have the pleasure to include the names of:—

My Editors, Messrs. Kegan Paul, Trench, Trübner & Co.

James Hardie, M.A., Principal of Linton House School, Holland Park.
My dearly beloved first master.

Stuart Blofield, D.Sc., Principal of St. John's College, London.

Sir Thomas Stevenson, M.R.C.P., &c., Guy's Hospital, London.

Dr. Douglas Cree, M.R.C.P., Finchley Road, London.

Dr. Henry Head, M.R.C.P., &c., 143, Harley Street, London.

Dr. A. Neish, M.R.C.V.S., Inglewood Road, London.

William Marriott, F.R.Met.Soc., London.

Professor Dr. L. Edinger, Frankfort a/M.

Sanitätsrat Dr. Döring, Berlin.

William J. May, A.S.I., Teacher of Physiology at the County Council of Middlesex Willesden Polytechnic.

E. M. Eagles, M.A., Prizeman of St. John's College, Cambridge; Teacher of Physics and Chemistry at the County Council of Middlesex Willesden Polytechnic.

J. Bartlett, M.S.A., Lecturer at King's College, London.

Joseph McCabe, Translator of Prof. Haeckel's Works, Author of "The Religion of Woman," etc.

Not for one moment, however, do I seek to awaken in the minds of my readers the false impression that the above gentlemen support me in the conclusions at which I have herein arrived, or that they even knew what I intended writing. On the contrary, it is only fair to them to state that most probably many of them will be energetic dissentients. Some also, I sincerely hope, will come over into my camp. In any case, they all acted in a kindly spirit and in the interests of science and of truth by independently and impartially giving me of that which they knew.

In like wise, when I, in the following, quote from an author or authority on one or more subjects, it is not to be understood that he or she intentionally uphold, sustain, or countenance me in what is herein expressed, or that I desire it believed that these writers shared my opinions. It is in many cases more likely than not, that if the citations in question are not actually employed to controvert the very standpoint taken up by myself, that they are at all events the words of writers dead or alive who, had they seen this work, would with all the means, intellectual and otherwise, at their disposal have opposed it.

There are three classes of opposers. There is one which, according to its knowledge and experience, conscientiously believes one to be in the wrong and candidly gainsays him (the noblest class); a second, a learned caste, which, whilst inwardly acquiescing in all said or written, openly and obstreperously with unwonted rancour denies the same, disputing every inch of ground hand and foot and head, wrongly conceiving, as it undoubtedly must, that it is no common property but its very own, and that all others are trespassers, poachers on their preserves ; and a third, containing certain categories of mortals which at present shall be nameless and from which I am expecting many very heated replies, whose wont it is with specious reasoning and prolix verbiage to indiscriminately run down and abuse all and everything which is not quite to their liking and with which they either cannot or more often against their own convictions, their better knowledge to the contrary, dare not or will not concur, or more frequently than not to give an opinion on a subject of which they have either read or heard only half—perhaps not even that, and not quite comprehended this little. This last is the most difficult class to tackle, for its members are *facile principes* of the art of obscurantism, all their writings are fallacious, and in all their utterances an intentional obfuscation of that writ in tomes or on those larger pages of the book of nature is in evidence. Efforts '*nodos in scirpo quaerere*'—to look for knots in a bulrush—is more likely to be rewarded with success, than to find in aught of theirs some tangible statement to refute.

On the end-results of this work especially, no fair criticisms can be passed, without having read, understood and thoroughly digested the entire; for it consists of one succinct, unbroken chain of proof. I do not mean to say that each link is perfect, as, in a production

of such wide scope is only too clearly to be expected, several of them are sure to possess one or many, more or less important flaws or blemishes, which will urgently need repair and finish; but to arbitrarily pick out one or more items and straight away to deny them without taking the context and that which led up to the point or points in question into account, were absolutely meaningless.

No proof or proposition herein set forth is dogmatically asserted, and it will give me extreme pleasure to be put right where I am wrong. To prevent any oversight and to facilitate my perusal of any articles for or against me which readers may think fit to remit to the magazines, reviews, and journals, or of the reports of any lectures given, I should be exceedingly thankful to be given due notice hereof, and this should be addressed to me at ~~my publishers, Messrs. Kegan Paul, Trench, Trübner & Co., 43, Gerrard Street, Soho, W.~~, who have kindly consented to forward any letters of information thus sent. In this wise, it may eventually be possible to indite a collective reply. I in no manner bind myself; but should this course be pursued, shall as far as in me lies, reply even to those of my critics who may not apprise me of their comments. It must, however, be clearly understood that on no consideration do I hold myself responsible either to friend or opponent for non-response, where no resort to the *modus vivendi* of notification has been made.

Any friendly communications, new bits of intelligence, statistics, or advice will be most thankfully received.

In conclusion: I have striven my very utmost to serve the truth as I see it, but do not pose as infallible. Should I have failed, should the tendency of this work be wrong, I shall fortify myself against despair by the consolation with which Burke has provided me, that

> "Though a writer may be wrong himself, he may chance to make his errors subservient to the cause of truth."

Yours as I am and
as you find me,
LEONARD JOSEPH.

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ERRATA.

Page 59, footnote, line 23, *for* "cauld" *read* "could."
" 120, line 30, *for* "chlorate" *read* "chlorine."
" 261, last line but two, *for* "other" *read* "ether."
" 265, line 22, *for* "watched" *read* "watch."

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BOOK I

PROLEGOMENA

"MANKIND thinks as it *can*, and believes as it *must;* and as belief is independent of man's will, and cannot be affected by motives, it is not a subject for praise or blame, reward or punishment. As a rule, men's own minds have but the smallest share in deciding their own faith,—for generally speaking it is fixed by the geographical accident of birth,—and therefore their future fate (according to the Church) is not entirely in their own hands."[1]

Maurice Vernes says that religions should be classified according to the races professing them ; and there can be little doubt that such a classification would in most cases be coincident. But this state of things is not going to last. Whole nations are going to support religions they do not believe in, simply to make dupes of those who are not so far advanced as themselves. England is a Protestant country now in name only. A part of the poor-rates goes to support Roman Catholic institutions.

We need only read the newspapers to continue this subject. From the usually very well-informed "Daily Mail" and its 24th August, 1905, number, I take, with the kind permission of its editor,[2] the following telegram *in extenso:*—

> "MASERU (Basutoland), Wednesday, Aug. 23.
>
> "Lerothodi, the paramount chief of the Basutos, who died on Saturday, was buried at noon yesterday at Thaba Bosigo, in the mountain burial place of the Basuto chiefs.
>
> "The funeral was attended by *Mr. Sloley, the Resident Commissioner, and other government officials*, and by some ten thousand natives, and the service was performed by *French Protestant missionaries.* The coffin was covered *with a Union Jack.*
>
> "Among the mourners were the *one hundred wives* of the dead chieftain and their lamentations and wailings could be heard from afar. Mr. Sloley addressed the natives, *paying a tribute* to the services *and character* of Lerothodi."[3]

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[1] Mr. Foote, in the "Freethinker," slightly adapted to present purposes.

[2] The editor, of course, is not bound to agree with my commentary, but I hope he does.

[3] The italics are mine.

From this can be seen, that although in most European countries one creed, for appearance sake, will not bury the dead of another creed, yet do we here find English (High Churchmen) and French (Calvinists) united in burying a man not exactly of their belief in "the mountain burial place" of the Basuto chiefs. The burial is undertaken by the British Government, with the use of the Union Jack to cover the body of a man with a hundred wives. The French Protestant!!! reads the service for, Mr. Sloley (for the English Government) pays a tribute "to the character" of a man with a hundred wives. Why this caps, by a long shot, Christ's praise of the character of Abraham, the married man, who made love to his maidservant. But I have not done yet. Even this has been topped.

The "Daily Mail" extracts, from the "Bangkok Times," the official "Gazette" of the Federative Malay States, the following order:—

> "Any male person over sixteen, residing within three miles of his mosque, who without reasonable excuse shall fail to attend prayers there every Friday or to remain at least one hour to hear the preaching of the priest shall be liable on conviction to a fine not exceeding one shilling for every such offence." August 1904.

or in other words, the *command* for an observance of Mohammedanism. This is quite a different thing to toleration. It is saying, "Believe any rubbish you like, marry as many wives as you like, if compatible with your income, but you must believe something and that something you must stick to whether it be right or wrong. Do not think, but believe what the priest tells you; do not employ the reason God Almighty has given you for this purpose, and leave progressive religion to the Church."

> "Experience produces discrimination, and teaching grows as ritualism fades."

Where shall we seek experience? Surely not in the archives of the Church, the birthplace of that very ritualism which clogs all the living limbs of our reason, and thus impedes every progress. I am no lover of hasty Hegiras from time-honoured institutions; I am not fond of startling innovations, am rather hederaceous in fact, but no organisation should lay an incubus on the efforts of man to control his own destiny. Of course the results of such efforts are dependent on his character and surroundings.

Then if not in the Church, where are to be our gleaning grounds? Where are we to seek for our information?

"Search the Scriptures, watch, and pray," is a proverb I first heard when a lad of about eighteen years, which since then has never

been forgotten, and which with but slight emendation I still accept. If the etymon of word or phrase is to be obtained, its broad and general, and not its narrowed, specially adapted meaning must be taken. Therefore the signification of "*scripture*" is a *writing* (Latin, *Scriptura* —*scribo* I write) and not only a sacred writing, or more strained still, the Bible. Adapting in the above proverb the wider acceptation of the term 'scripture,' the sense is highly enhanced, and its truth more brilliantly evidenced. "Search the Scriptures" then becomes but another expression for 'examine the writings': *i.e.* the results of the researches and investigations of wise men of all climes and ages having been recorded, a close scrutiny of these scripts, whether as cuneiform impressions in clay or chiselled in stone, either as hieroglyphics or letters, whether with the qash on papyrus, the stylus in wax, the quill or steel pen or the printing letters on paper, is an essential. A single work is insufficient testimony on any point. Even a single collection of works is to be mistrusted, for there is no guarantee that the collector is not one-sided or biased in his views, and that the works he accumulates are not such as are not dangerous to his principles and tenets. A state library in a Catholic land contains no books fundamentally dangerous to Catholicism, and that collection of books, chronicles and records which in one binding we call the Old Testament is dedicated to the offspring of Jacob, a shepherd king, whilst the so-called New Testament is the biography of a great social reformer, a supposed descendant of this Jacob, and is written by friends and disciples. Old and New Testament are called the Bible. Please note that I do not say that the Bible is untrue: I merely note that its evidence *alone* is for me insufficient. If, and in how far the evidence can be corroborated or no, we shall see.

After essaying to the best of one's ability to undertake this task of perusal, important difficulties soon loom ahead. In writings of various authors we find the most glaring differences of opinion, perfectly startling discrepancies, and vivid contradictions. What is here to be done? Are we to pick out the most experienced, and blindly act under their guidance?[1] I fear this plan is fraught with much danger. Many a man or body of men—even highly experienced—does not always write according to conviction, but to suit a profitable purpose. Then again, it is difficult to judge who is the most experienced; and the man of most experience may yet not have found the true locus for study, whilst a comparative novice

[1] The Catholic esteems the supporters of his Church the most experienced, and *blindly* follows the teachings of his Church.

may be right on the site essential to substantial finds. How can one decide? The second part of our proverb—and proverbs are worldly wisdom—tells us to "watch." We are to be on the look out, and to look attentively; we have to observe, to think—we, and not another for us—and having made our own observations, we are the more competent to sort and check the evidence of others. Perhaps that may be found for which others sought. On the other hand, our own testimony may be based on false grounds of inquiry, we too may be too one-sided. Is this barrier insurmountable? What does the proverb tell us? It counsels us to pray. "Pray?" you will say. "To whom shall we pray?" ask the sceptical. "Will our prayer be heard?" cry the doubting—and many another similar question. The answers are not easy, but if you will be good enough to follow my relation of the difficulties with which I had to contend, and how I satisfied myself on this point, I think it will also suffice for you.

From nigh a baby and upwards, I had been taught to pray to a being called God, the nature and attributes of whom, in infantine ignorance, I failed to understand. As I grew apace, and the attributes of this God were explained to me, the reasons I should pray to such a God became ever less defined. Some of this deity's conceptions were nigh inconceivable and revolting. These feelings have been shared by another, and are beautifully expressed in a poem "Mein Glaube," written June 25th, 1830, by the celebrated German astronomer Johann Heinrich Mädler,[1] and to which I append a good free English translation, for the production of which I am indebted to the kindness and very able pen of Mr. Joseph McCabe.

MY FAITH.

1. Nicht jenen Gott den man Jehovah nannte,
Der heute schafft und morgen schon bereut,
Des roher Blutdurst kein Erbarmen kannte,
Den Feind des Mitleids wie der Menschlichkeit;
Der wilde Löwen in die Hütten sandte,
Weil man ihm keine Tempel noch geweiht,

1. Not mine the God whom men Jehovah called,
The God who could repent what He had made,
Whose lust of blood, to pity unenthralled,
Disdain of human gentleness betrayed;
Who with fierce lions hearts and homes appalled
Because no temple gave him due parade;

[1] Published in "Die Gartenlaube" of 1895, No. 2, p. 35.

Der nicht erröthet, Diebstahl zu befehlen,
Und hinterher gebeut: Du sollst nicht stehlen!

2. Auch das Phantom nicht, das dem kranken Hirne
Des Mönchleins Athanasius entsprang,
Und dem ein Pontifex mit frecher Stirne
Von blinden Irrenden Respect erzwang;
Wie der gesunde Menchensinn auch zürne,
Das ungeheure Wagestück gelang,
Das Schwert muss die Vernunft darniederhalten
Bis man den Gott, den einigen, zerspalten.

3. Ach! tausende von Scheiterhaufen brannten
Dem Zerbild, das aus solcher Quelle stammt,
Für alle, die sich nicht zu ihm bekannten,
In den noch ein Gottesfunke flammt.
Und nicht genug, dass sie den Leib verbrannten,
Die Seele ward zur Höllengluth verdammt
Von jenen Pfäfflein, das die Welt verblendet,
Das heiligste der Rechte ihr entwendet.

Who counselled those that worshipped Him with zeal
To plunder, yet decreed: Thou shalt not steal!

2. Nor mine the phantom-God that next was born
In Athanasius' sickly, monkish brain,
While rampant popes, ruling a a world outworn,
For him respect secured, for themselves gain,
Despite the strong and honourable scorn
Of every soul that stood both free and sane.
Only that reason was with sword derided
Could God, the One, be thus in three divided.

3. Ah! See the murderous flames at length broke out
To force that image—false and justly spurned—
On men whose mind iniquity would flout,
In whom a real spark of God yet burned:
Martyrs, whose very souls the pious lout
For ever in the flame to dwell had learned
From the pale priest, who had the world befooled
To be by him, as God's own Vicar, ruled.

From the time I first began to doubt, I diligently sought to follow the sound advice of Lord Bacon:—

> "Read not to contradict and confute; nor to believe and take for granted; nor to find talk and discourse, but to *weigh* and *consider*."

The italics are mine.

Contradicting and confuting are in the hands of Foote[1] and his commensals, believing and taking for granted is according to the

[1] Editor of the "Freethinker.'

manner of the Church and its parasites, whilst vain talk and discourse is held in the now fashionable debating societies and kindred institutions. How few really weigh and consider! At first, although I considered, I yet doubted. Well could I cry with Elizabeth Prentiss—

> "Of all the anguish in the world there is nothing like this; the sense of God without the sense of nearness to Him."

Night after night have I lain awake in bed, bathed in tears. No one who has not felt the throes of this mental evolution can ever conceive of the utter darkness, the horrors that overwhelm one, as one feels the sole support gliding gradually from his grasp, and the intense tortures of such a void become as sensible as an air-exhausted vessel suffers from the atmospheric pressure round about it. One is not used to being independent in thought, and this break with habit is that which gives the pain. R. W. Emerson tells us that—

> "God offers to every mind its choice between truth and repose. Take which you please—you can never have both. Between these, as a pendulum, man oscillates ever."

This was my case.

It was Professor Dubois Reymond who woke me from my moral and religious[1] torpor. He preached at the Berlin University, under the cloak of Natural Science, laws which if laid down would lead to Atheism. At first I humbly and unresistingly followed him, like unto one of the five to six hundred lambs of the flock that weekly thronged the hall to hearken to the utterances of this undoubted scientific bellwether. Later on, his lectures began to have quite a contrary effect to that intended. I became restless, uneasy, unhappy by turns. A metamorphosis was going on within me. As the poet expressed it:—

> 1. "New passions are awakened within me,
> New passions that have not a name;
> Dim truths that men knew but as phantoms
> Stand up clear and bright in the flame.
>
> 2. And my soul is possessed with yearnings,
> Which make my life broaden and swell;
> And I hear strange things that are soundless,
> And I see the invisible."

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[1] A distinction must be drawn between religion and morality, because religion is dependent for its morals on the morality of those professing it. This is true even of a religious founder.

I was determined to think for myself. I seized hold on Damoclean science as it hung aloft, grasped the instrument which had been so powerfully and mercilessly wielded against me. Nature, my teacher's mighty ally, became mine, I roused myself, I fought and strove, and regained much that had been stolen from me (though not all). But darkness had vanished.

It was in this state of mind, exalted and elated, that I started writing this work. I intended telling the world of the grandeur of my find. But, warned by experience, we shall not be hurriedly transported from place to place, and I shall lead you step by step, so that no markings shall be lost to sight. On each prominence a pause will be made, to take in a comprehensive general view of the country already passed, and of the paths trodden. Shall we here and there be affected by what we see? Most likely. New experiences may give us new ideas, new conceptions, and the view may be continually changing, as the winding paths give first one aspect and then another. The only thing we can do, so as not to get lost, is to keep as near as possible to the path, but, as to forming opinions, follow Emerson, who says that—

> "If you would be a man, speak what to-day thinks in words as hard as cannon balls, and speak what to-morrow thinks in hard words again, even though you should contradict everything you have said to-day."

Do not fear here and there retracing your steps—contradicting yourself. This is far better than running into danger. By the time the summit has been reached, some conclusion will have been formed.

> "They are ill discoverers that think there is no land when they can see nothing but sea,"

Samuel Maunder would say.

Let each one strive to use his reason to discover the principle of the Universe. I am not fanatical enough to assert that independent search on the part of the reader will find for him the same beautiful goal I found, but he will at all events find one the attributes of which are conceivable to his reason, which is therefore sufficient for his needs, and this in itself is happiness. This is the way to seek the truth.

Once more to quote Emerson :—

> "He in whom the love of repose predominates will accept the first creed, the first philosophy, the first political party he meets—

most likely his father's. He gets rest, commodity and reputation; but he shuts the door of truth. He in whom the love of truth predominates will keep himself aloof from all moorings and afloat. He will abstain from dogmatism, and recognise all the opposite negations between which, as walls, his being his swung. He submits to the inconvenience of suspense and imperfect opinions; but he is a candidate for truth, as the other is not, and respects the highest law of his being."

Hoist the flag! Let 'progress' be parole, and the watchword 'truth.'

"The child is father of the man,"[1]

but, says Cowper,

"Such dupes are men to custom, and so prone
To reverence what is ancient, and can plead
A course of long observance for its use,
That even servitude, the worst of ills,
Because delivered down from sire to son,
Is kept and guarded as a sacred thing."

And truly, servitude of mind it is not to be permitted to use one's own judgment. The sooner such fetters are broken, such trammels thrown off, such bondage ceases, the better will it be for mankind. So long as Bigotry and Fanaticism reign supreme, either in the family or in the national life, so long will Truth be obscured from the masses. There can of course be no doubt that "Justification by works" is demanded by a God (however we may conceive Him), and that

"before the all-Righteous Judge opinion is nothing. Goodness is all. Religion makes no difference in the nobility of human life on earth,"[2]

but common-sense tells us that we are bound to pray with more earnestness, zeal, and devotion; we are less prone to doubt, less liable to deviate from the path of duty if we come to some firm conclusion as regards the nature and attributes of the God of our worship.

It may be asked: "What has this to do with the question which has been adopted as a title for this book: 'What are we?'" Only when we can comprehend what God is can we know our position to that God, can we form some notion of the universe wherein we live, what our position is to that universe, and what we are.

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[1] Young's "Night Thoughts."

[2] "Toleration and Simplicity," by Claud G. Montefiore, being an article in the "Jewish Chronicle" Jubilee Supplement (London), November 13th, 1891.

"Few people,"[1] says Claude Montefiore, "however, care to inspect the weaknesses of their own views." For those who do, and are desirous of gaining some clear idea, for those who have not the time for initiatory study, these chapters are written, so that from my conception they may obtain a basis for theirs. Take heed throughout the perusal, of the key-note: "Search the Scriptures, watch, and pray." Wherever I can, I quote the scripture in preference to using my own phraseology. I have found that there is some good in everything, and therefore when I make use of the words and utterances of another I accept the author for the point at issue, but it must on no account be assumed nor understood that he or she is accepted by me either *in toto* or *in parte* unless expressly stated.

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[1] *Vide* footnote [2] to p. 10.

WHAT ARE WE?

CHAPTER I

DEFINITIONS

BEFORE we begin to be cosmogonists, before we set out to study the universe in its entirety, what the world and what our position in the same is, it is very necessary indeed to have before us some criteria on which to base our criticism. What guidance have we? What do we actually know? What do we not know? Every conception, every idea and notion which one believes to have clear, becomes very unclear if one starts analysing, as soon as one essays to give it an expression in words. The definition becomes, to a thinking individual, very unsatisfactory. Each term, each word of it, is in itself an unknown quantity, which in its turn has to be explained.

We feel, we see, but we do not know at the outset, what feeling, what seeing is. Even if we imagine we do, we do not know if we have seen aright. We require to have the same sensations repeated often, before our brains are capable of describing the sort of sensation, or can classify it in its order to other sensations.

Then again, there are many causes of error. Our nervous system is not so perfect as it might be. If two needle-points be presented, close to each other, to the tip of the finger, each needle can be separately felt, but if two finger-tips be pressed on to the back, close to the spine, it is difficult, it is nigh impossible to say if one or two fingers are in contact, there being in this part of the body less nerves and less sensitive ones. As a rule, sneezing is caused by an irritation on the inner nerves of the nose. Sudden light can, however, produce the same effect, as the optical nerves in question are close to the mucus membrane, and so a sort of induction is set up. This induction may possibly, even probably, be set up in other instances by other currents of thought.

When we look at an object, the thing seen appears in each case in a different aspect, according to the medium (air, glass, crystal or other

prism, water, &c.,) through which it is viewed. Which is the right view?—or is perhaps the true view another, different to all these?

Touch, sight, all the sensations in fact, are, however, the result of irritations. It will therefore be as well to begin with a definition of irritation,—not of the word i-r-r-i-t-a-t-i-o-n, but of that for which it stands, of irritation[1] itself.

IRRITATION is the intelligent recognition of a sudden or unaccustomed (not often repeated) movement of some of the particles of our body by those of another, either separately or *in toto*. The movement must be recognised, because without *recognition* there were no irritation whatsoever. When a finger is cut with a sharp instrument there is no irritation, because the action of cutting crosses the nerves at a speed greater than that of the physical, chemical, or physical-chemical action set up and transmitted from the point of section to the brain. Again, much is not felt, not tasted when the eyes are bound. The movement must be sudden or unaccustomed, for were it gradual we would become so used to it that we should cease altogether to take note of it.[2] The phenomenon can in some cases be compared to a common Leclanché battery, which ceases to act when long in continued action. In other instances, it may be likened to the induced current of an induction coil, which cannot exist without a current-break or interrupter.

Whereas the intelligent recognition of a movement is irritation,—the intelligent recognition of an irritation is

Feeling.[3] Feeling can be real or imagined. A child does not know what is real. When a child is teething, and it cries, we say the pain of teething is making it cry. May be, and most likely, the child does not know that the coming of the teeth is the cause, but its crying tells us that pain is to the child a reality. Its first cognitions are real. Only after several impressions have been recorded can it 'imagine.' A new-born child has no imagination, but as soon as it has gained some experience, it *believes* it feels (the feeling is momentarily real:

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[1] Our language being, alas, a poor one, "Irritation" is alike the act by which a sensation is brought about, and the sensation itself. It is in the latter sense that I use the expression here.

[2] The greater the movement (molecular, or electronic displacement in the nerves and then in the brain cells) the more gradually must such action take place, if no irritation is to be felt.

[3] We do not know for certain at this point of our research what intelligence is, nor what is and what is not intelligent, nor do we know where to find the seat of intelligence. A fish has no brain rind, but, as far as our observations go, it has sensations, i.e. intelligent recognition of certain irritations, of touch, sight, taste, and so on. If plants, too, have feeling we shall see later on.

for the imagined is real to the person imagining it at the instant he imagines it, the contradictions are eliminated) *i.e.* believes it recognises an irritation, believes it recognises a sudden or unaccustomed movement which at that moment has not taken place. When older, it may, for instance, know that a peculiar movement on its body gives the sensation of tickling. If then, a second person pretends to tickle, this deed may so occupy the mind of the child that the child really feels tickled, the muscles of that part of its body which it believes attacked will quiver, will convulsively contract. The movement of the operator, and the receiver's thought of tickling, together with the consequent movement of muscle, all this has been registered, stored in the brain.

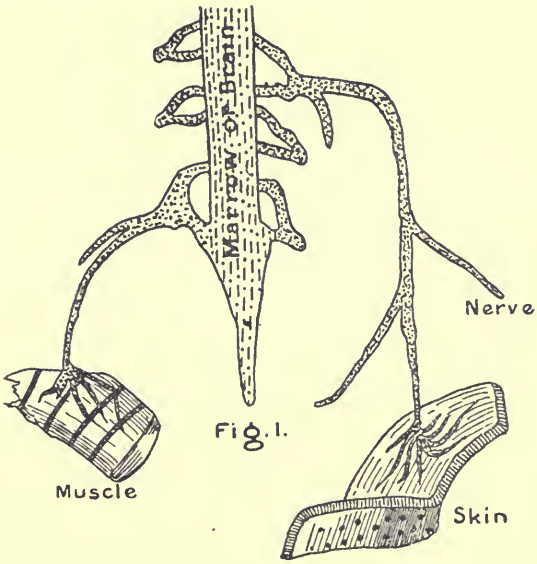

Fig. 1.

When the child sees again an exactly similar motion to that which was formerly employed to irritate its body, the association of ideas is so rapid that the brain does not wait till the body *is* tickled, it *feels* or imagines itself tickled, and the muscle moves. This lateness of action of muscle contraction *after* an irritation of the skin has taken place is due to the reflex action of the brain (*vide* Fig. 1.). As seen, the action on the skin is transmitted to the brain, the brain records it, and then wills that the skin surface touched be removed from that touching it. If the movement causing tickling now ceases, this cessation is also telegraphed to the brain, or more

properly speaking the molecular motion (physical or chemical action) ceases in nerve and brain, and at once the brain wills the muscle not to remove the body. This counteraction, these opposed manifestations of the, we will term it will-force, which first desires to move and then to not move the muscle, causes the convulsive movement, the quivering. The quivering of the muscle imparts, may be, its movement to the adjacent flesh, and the nerve cells in connection herewith are also set in motion.

The reflex action of the brain is the source of many an error in our conception, for time is lost. That is to say, an action *appearing* or *seemingly* alone may be followed quickly by another. Were it known, *i.e.* conceived by the brain, that the first-named action was not independent but dependent, it might have obtained quite another impression of the proceeding as a whole. The recognition of a tickling—or in fact of any other action—which has not taken place, but which has once or more been *formerly experienced*, is 'imagined,' the thing seen or felt 'a thing of the imagination.' But, as above mentioned, the thing imagined is actually seen or felt, is real as long as the imagination lasts. Thus, if you pretend to tickle a person, that person may contract his muscles in the belief that he has been tickled, although you may not have touched him. A word may represent a given, and in connection with other words, a well-known, already experienced action. When nothing is seen or felt, but this word heard or even read (seen), the entire apparatus registering the result of that action for which the word stands is set in motion, and the brain imagines that the action in question is momentarily going on. In this manner, everything which one has once experienced may be 'imagined,' the stores containing impressions of past things and events (the memory) are besieged (is awakened, *i.e.* the contents of the storage cells is set in motion), and the imprisoned thoughts and impressions are set free by outside forces. I believe that this idea that words are forces indirectly acting on us is best practically illustrated. If the proverb "laugh and grow fat" holds good, then do I hope with words to add to the weight of ever so many of my readers. I take my text from the first supplement of the "Berliner Lokal Anzeiger" for July 25th, 1903, and what is related is told as fact.

"A citizen of New York had lost his mental balance, but instead of being overcome with melancholy and fits of crying, as soon as the screw in his cranium relaxed, he was suddenly seized by an uncontrollable fit of laughing. It was really funny to see him laugh. He

laughed by day, and he laughed by night. He laughed in standing, in sitting, in lying. Whatever he did, whatever he undertook, wherever he went, and where he stood, from his mouth resounded hearty, lively salvos of laughter. But his merriment and mirth disturbed the rest of his neighbours. They could not work, they could not sleep for the frolicsome, wanton, perpetual hahaha! hahaha! of William Riley. They summoned the police to free themselves of the laughing coon. Two policemen found him in an arm-chair holding his sides for laughter. All their questions he answered with his jolly hahaha! hahaha! Laughing is catching. The two men tried to be earnest, but in vain. In a few minutes they joined the laughter with all their might in an unrestrainable ha-ha-ha! ha-ha-ha! Unbridled laughter filled the room. The more the two laughed, the more laughed Riley, and the more lively Riley became, the louder roared the policemen, till they were nigh to rolling on the floor for laughter. The neighbours came in in a rage, but the joyous cheery laugh of the trio was contagious. They too laughed. The walls verily vibrated with the ha-ha-ha, ha-ha-ha, of the laughing chorus. After a sort of relaxation had set in, they managed to overcome the laughing bloke, who still laughed on with undiminished vigour, and drove him to a hospital. Here the dance began anew. Although the head doctor tried to make an earnest face, Riley infected him, despite his seventy years. The infection spread to the other doctors, and the consulting room was transformed to Bedlam. All shook for laughter. Riley was transferred to the sick-room. In five minutes the risible faculties of the patients were awakened, and a never-ending hahaha-a-hahaha! filled the hall till the patients nearly rolled out of their beds with laughter. Riley had—to prevent more damage—to be conveyed to an asylum."

If the reader has even smiled, or if the recitation has had any other effect, even the reverse, I have shown what an effect words have.

There are other phases of the above relation, such as the contagion of laughing, gaping, crying, singing, and dancing, and the tendency to imitate, all of which together require a work of their own for special treatment.

But now to return to 'imagination.' I had said that by means of words imagination is awakened, and that thoughts and impressions would thereby be indiscriminately let loose. Imagination is therefore the great incubator of error and discrepancy, for in the first instance, it is not always easy to discern the imagined from the

real, and secondly, so many different thoughts of various experiences are often to such an extent simultaneously and indiscriminately let loose (the 'registrations' of impressions being packed so near each other), that the imagination no longer depicts an integrity, but mixes up so and so many conceptions together, and one believes he sees things or deems himself conscious of feelings (sensations) which never, or did not momentarily, take place.

When one describes in tone (music), in colour (painting, drawing, etc.), in written words, or words of mouth, that which one imagines, he is either said to be talented or idiotic according to the ideas (judgment) of others, if that which he describes be beautiful or revolting, clever or foolish, and the like. These ideas of beautiful, clever, etc., on the one hand—revolting, foolish, and so on, on the other—are but relative expressions, vary in each individual mind according to the experience, the standard of knowledge of the judge, and have no fixed value. An excessively talented man, one who most beautifully describes in word or sound, or one that imagines a successful invention or discovery prior to the discovery, is a 'genius.'[1] That imagined by a genius may be, most probably will be verified, because what he imagines is accepted as probable or as good, beautiful, or profitable by others. A person whose ideas are abnormally revolting to and inconsistent with those of his contemporaries is mad. He would perhaps not have appeared a madman to his ancestors; he may not perhaps appear a lunatic, but a genius, to future generations.

When the myriads of brain cells are overcharged, when the action in them is too lively (excited), when exhausted, when they are temporarily put out of order by morphium, opium, cocaine, and so on, or are durably out of order (insanity according to us) the registered impressions

> "Rise up and come across the consciousness so vividly that one cannot distinguish between them and real objects."[2]

The thing that is under such conditions seen is a '**Hallucination.**'

Hallucinations are also caused by the temporary action of such

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[1] The inventor himself only then is a genius when he conceives the new principle or machine or process prior to his actual realisation of it. A genius does not always see the results, he is not always a realiser, as is the inventor. This view of the matter is not, I believe, the one usually accepted.

[2] *Vide* article on 'Hallucinations,' by Dr. T. S. Clouston, in "Chambers Encyclopædia."

mediating[1] forces as hypnotism, suggestion, or temporary brain derangement such as trance, the state of being moon-struck, the somnambulistic condition and the like.

As soon as a child has had experience, but before it has had sufficient experience to be able to discriminate between what is real and what is not real, most likely nearly all its conceptions are of the nature of hallucinations.

The difference between a 'hallucination,' and 'a thing imagined' is, that whereas that imagined can on after-thought be possible of execution to the person imagining, and pertains to the past, present, and future, a hallucination is on after-thought recognised as impossible.[2] It could not have existed, taken place (been real),[3] and being *only material* as long as it lasts, is confined to the period during which it lasts. Although no longer existing (no longer real), objects can be seen, but these can be seen in the present, and the surroundings are present.

An **Illusion** is in effect similar to a hallucination, but differs in cause, and can be otherwise distinguished. Whilst hallucination is the result of a not yet ordered or of a disordered brain, an 'illusion' is conceived under so-called normal brain conditions, and often, though not always, that acknowledged as seen by one part of the brain is recognised as not real (non-existing) by another part of the brain. Illusions can be of two kinds: (*a*) 'abstract,' and (*b*) 'real.'

(*a*) An '**abstract**' **illusion** is the erroneous conception of the existence of some abstraction, or of an act in abstract conception; it is the result of want of, or of insufficient knowledge, and caused by efforts of will[4] (voluntary or involuntary) whether of the person himself under illusive impressions, or of other persons, living things, or other forces.

A person can, by force of will or thought, think that people he knows are sitting at home, whereas they are really out of doors. He must, however, at the moment not know this. If he pictures to

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[1] The word 'mediating' used in this sense is new, and I thereby mean a combination of the two ideas 'a plying between' and 'acting as a connection between.'

[2] Actually the expression 'impossible' is vague and misleading; for everything that, under given conditions, is not deemed probable of execution, can be thought possible, is conceivable as taking or as able to take place under other conditions, and conditions are ever altering (evolving).

[3] Real, *i.e.* existing, whether as matter or force. What matter and force are, whether they differ and if so, in how far, etc., we shall see later.

[4] 'Will' will be treated of in a following chapter.

himself this thought, seeks to realise this false notion, or fancies he sees the people in their room, then has he the illusion that they are at home, for it is not true, not a real fact. Had he knowledge that they had gone out whilst he had imagined them to be at home, he would not have an illusion.

Another example: a young woman pretends—exerts will to do all that will make believe—that she loves a man. The man sees behaviour which, up till now, experience has taught him to be dependent for existence on the existence of love, and he has no knowledge that she does not love him. But as this love for him does not exist, it is an illusion. Like an imagined thing, the illusion is, for the dupe, a reality, as long as he has no experience of duplicity. It can, however, at the same time be known to be an illusion by outsiders. The illusion ceases with the moment it is known (been found out by experience) that the love is not real but simulated.[1]

(β) A **Real Illusion** again, can be subdivided according to the causes of which it is an effect.

An *optical* illusion is the conception of recognising (in this case seeing) one or more objects which at the time of seeing, or which later on, experience teaches us that it does or did not exist, or did not exist in such wise or condition as we at first thought. It is the effect of (caused by unfavourable conditions for the employment of the optic nerves and system generally, or by) reflection or refraction of light—'*reflected*' light being the light thrown back by there being

> "a difference in the transmissability of ether-disturbances[2] on the two sides of the bounding surface";[3]

whilst 'refraction' is the bending out of course of any force-waves

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[1] 'Simulation' is the act of representing oneself in a condition or state (whether of body or mind, physical or psychical) not felt by the representer at the moment of representation. He makes similar or like movements of body to those he knows to be incident to the state which he wishes or wants to have acknowledged as his. I say he *makes similar* movements, and do not say he *reproduces* movements, because no action or object can ever be *re*-(again)produced. The original can be exactly copied, (be a true copy) an exact image, it has not been produced a second time, but something similar in all respects has been done or made. As soon as a single discrepancy exists, there is no longer a state of similitude, the object produced is not a facsimile, it is an 'imitation.' It must not be thought I am seeking to split verbal straws. For common parlance, laxity of expression is, although not recommendable, excusable. For a clear conception of the universe, a most precise mode of expression is an essential.

[2] A sufficient definition of 'ether' for the present, is that it is the fine medium or matter which is supposed by some to permeate all space, and acts as mediator of sound, heat, light, electric, magnetic, electro-magnetic, actinic and other waves and oscillations.

[3] *Vide* art. 'Reflection,' in "Chambers' Encyclopædia," by Dr. Alfred Daniel.

(light, heat, sound, etc.) when travelling in one transparent[1] medium and impinging obliquely upon the surface of another transparent medium. Refraction is therefore apt to cause a false impression as to the size of objects, and the direction of rays of light. These false conceptions are illusions, but apparently real till experience has shown what the true size of the object, what the true direction of the ray was. The object seen in a mirror (*the 'virtual image'*) is an illusion caused by reflection; seen behind lenses, it is *an illusion* caused by refraction; for experience tells us that the object itself is in front of, not behind the mirror or lens surface.

A **Real Image** may or not be an illusion. A real image is such a copy of anything that it appears as a likeness of the original, but there is no pretence that it is itself the original. It can be in any material (then it actually exists) or immaterial, the result of reflection or refraction when the image is in front of the polished surface or lens (then it is an illusion).[2] A real image differs therefore therein from an '**Imitation,**' which, although of other matter, nature, or structure, pretends to possess the same attributes as the original.

A '**True Copy,**' on the other hand, is one which must be in the same materials or immaterials or illusions as the original. A 'true copy' can also be the representation of actions or movements (efforts or exertions of force) which have taken place.

'*Mirage*' (*vide* any Encyclopædia) is a special form of optical illusion. In like manner an *echo* is an illusion (it is the reflection of waves of sound), if the person hearing it believes it to be the sound originally produced, or even if he recognises it as not the original tones. As far as the existence of sound itself is concerned it is as real to the ear as a real image (result of reflection) is real to the eye.

But I find I have been frightfully, although necessarily, digressing. It shows, however, how very difficult it is to come to a clear understanding, the chief difficulty being to be able to lucidly express oneself, for there is hardly a word which has not to be defined, and the available terms for a good definition are soon found to be themselves

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[1] 'Transparent' is the attribute for the characteristic of all bodies which, by nature of their molecular structure and consequent reflection of all light reaching them, permits of a person recognising objects which are on the side of, or inside the transparent body away from the spectator. The characteristic or state is 'transparency.'

[2] For it is not then, in the mind of the seer of the illusory image, the true or real object,—at least, not after he has once recognised that the image is the result of reflection or refraction.

needful of explanation. These fine distinctions show moreover in how many ways we may err in our conclusions, these being gained from images, hallucinations, and illusions, and not from realities.

To continue on our course :—

'Feeling' has been defined as the "The intelligent cognisance of an irritation." To feeling, the conceptions of space (locality), cause, and time, are not necessary; these come later on.

When a child is born, its first feeling, its first experience, *i.e.* its first cognisance of an irritation, is probably that of the visual nerves, *i.e.* that of light; but it is very long before observation and experience give the child its first cognition, though it were hard to say which was the primordial cognition. I believe it to be no triviality to assert that the first positive knowledge was one of negation,—a certainty that the light, of which it becomes sensible, is not to be touched or grasped.

Be this as it may, it is decidedly of great interest; but our want of knowledge on this, as on so many other subjects, is no permanent hindrance to our general conceptions. An infant has perhaps irritations of which it takes cognition even in the womb. Of this, however, we have no experience. But *our* first observation of the child (and this is for *us* determinative) is, that it has as yet received no irritation from the outer world of which it itself has taken mental account.

As soon as a child has felt more than once, it becomes cognisant of states or conditions; it begins to compare; but it has not, as many philosophers would have it, a knowledge of its "*ego*," of its being, its existence, or of its normal condition,—in fact, it does not know that it is itself. All that comes by degrees.

At first a child feels, it is cognisant or *conscious* of a sensation. We shall, in Book II., Chapter ii., have occasion to discuss 'consciousness.' But at all events, all that it is necessary, for the moment, to understand is, that there is a difference between consciousness of a sensation and the consciousness or afterthought that it is I, I myself and no other that feels. The knowledge of individuality, of separateness from all around one, can only come after much experience.

After a child has felt or become cognisant of two states or conditions, or felt one state and found the next instant a want of this state, it has its first experience.

It is immaterial if the conditions observed be external, internal, or external and internal.

The degree of feeling of which we are conscious, the degree of intelligence as accognised by us, are both dependent on the length of experience, the number of opportunities for increasing it, and the fineness, delicacy and sensitiveness, the sensibility, and the accuracy, and constituency of the nervous system.

Actually, there is but one so-called sense—sensibility (cognisancy [1] of sensation),—but experience has taught us for convenience of speech and facility of comprehension, to adopt a separate name for the sensibility of each of the five important (predominant) centres of our body—ears, eyes, nose, tongue, and muscles,[2] as well as for the nerves in general, and thus the six senses—'*hearing*,' '*seeing*,' '*smelling*,' '*tasting*,' '*feeling*' (touch, a sense of contact in general), and *muscular sense* [3]—evolve. The five centres we call '*organs of sense*': probably because we recognise therewith, we have sense for, or see sense in, the space outside us, and within us.

The nerves of these organs increase in sensibility in direct ratio to the amount of use to which they are put, and up to a certain point, the degree to which they are exercised, and they do not develop together but successively. In fact we are led to say that the six senses are the offspring of experience (lower organisms, having less senses), *i.e.* are results of comparisons between a state of rest [4] and an intelligent recognition of an irritation.

A **Reality** is that which exists, is, and of which the senses become conscious for the person or thing feeling, at the time of feeling.

This can be a possibility or probability to others (agnostics). To the person feeling it, it can be conceived to exist independently of the person conceiving it.

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[1] The word 'cognisancy' is self-coined.

[2] We group the nerve centres according to the facility of certain of them to act and re-act upon (become cognisant of) given causes or influences and the degree of these influences. If one place food on the tentacles surrounding the mouth of an actinia (anemone), a simple organism of cœlenterata, these immediately draw the food into the mouth. Lob in Chicago (*vide* "Haben die Fische ein Gedachtniss," by Prof. L. Edinger, Frankfort a/M) saw the same action of the tentacles even when there was no mouth. This tropism—tendency to act on a given irritation—is very probably the origin of the sense of touch, just as photo-tropism (sensitiveness to light) may be the origin of the sense of sight. (*Vide* footnote [3], p. 14.)

[3] "Chambers' Encycl.," art 'Sensation:'—"Many authorities deny the existence of such a special sense altogether, and believe that it is merely a form of ordinary tactile sense. But that it is not so is frequently illustrated in a disease of the spinal cord, locomotor ataxy, in which there is, when the eyes are shut, a more or less complete absence of knowledge of the position of the limbs and of the power of regulating their movements, although their cutaneous tactile sensibility may be quite normal. It would appear likely that the nerve endings connected with this sense are situated in the muscles, tendons, and joints, and that these are stimulated by changes in movement and mutual pressure in these structures." (*Vide* also p. 90 of this work.)

[4] We shall see later that the word 'rest' would have been better rendered by 'lesser motion,' since perfect rest does not exist.

It will in this work be shown, that the only 'realities' to me are the various forces or force-forms of the universe.

When Bilharz[1] says,

"In der That: das einzige Real-object, das wir kennen, sind wir selbst,"	"The only real object that we know are ourselves,"

I cannot agree with him, for I actually know no more of myself, than I do of the forces without me. These (for I conceive of myself as a conglomeration of forces (*vidè* Chapter ii.) and myself are part of an entirety. When I am no longer body, yet I am in other form, and real is the entire, independent of my conception of it. But this is going too quickly ahead, you will not be able to follow me, and I must retrace my steps.

A **Deduction** is the resultant of an individual's mental comparisons between feelings or/and experiences.

It is an abstraction, but as such, it can be real or abstract, *i.e.* a real abstraction or an abstract abstraction.

A deduction is a real abstraction when the mental comparisons are set up between two or more 'realities.'

A deduction is abstract when the mental comparisons are those between realities and abstractions, or between various abstractions.

I only use the word 'abstraction' for the sake of perspicuity, as actually an abstraction does not exist, it is itself an idea of relation, of comparison.

I can express myself otherwise, by saying that a deduction is real when the mental comparisons are those between present experiences or/and feelings; and abstract, when the comparisons are made between past experiences or/and feelings, or between present experiences or feelings on the one hand, and possible or probable experiences or feelings on the other.

Reason is the force by which one makes deductions from the comparison of the various effects felt by oneself, or probably felt by other persons and many animals, or from the comparison of what others believe to be real, possible, probable, impossible or improbable, abstract or illusive.

Knowledge is an intelligent compilation of feelings, experiences, and deductions made by oneself, but not necessarily of oneself but also of the universe generally.

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[1] "Der heliocentrische Standpunkt der Welt Betrachtung," by Alfons Bilharz; p. 287; pub. Stuttgart, 1879.

'Knowledge' is real or abstract accordingly as the feelings or/and experiences are of the present or of the past, and the deductions made in the present or in the past. Real or true knowledge can only be in regard to present conditions.

The word 'Experience,' in its narrow sense, is not used in this work, as not deemed fit, and is replaced by the word '*Feeling*.' In its wider sense,

Experience is the mentally registered intelligent comparison between two or more efforts of reason, the resultant of two or more acts of reasoning.

One can thus speak in the plural of some or of all of my experiences.

Kant[1] says,

"Was mit den materialen Bedingungen der Erfahrung (der Empfindung) zusammenhängt ist *wirklich*."

"That which belongs to (or has to do with, or is in connection with) the material conditions of experience (feeling, sensation) is *real*."

This definition is nearly mine, but not I believe quite so lucid. The word 'Experience' is used by Kant in its narrow sense for that of which one is conscious, which one feels, and then again, the expression 'zusammenhängt,' even if translated 'is in one with,' is very undefined. Two is not one, and one is not two. Feeling is one thing, and the real or existing things are something else. To me it seems nonsense to say: 'The things which are in one with the material conditions of feeling (consciousness) are real.' On the other hand, if 'zusammenhängt' is meant by Kant for 'belongs to,' 'appertains to,' or 'has to do with,' then is the definition still worse, for there are many things which are *in connection with* experience, (feeling, consciousness[2]) or in connection with realities, and yet not real.

It must also be borne in mind that, things are only real to the person feeling them. Although another may apparently be in pain, and is possibly and probably in pain (all circumstances and conditions seemingly pointing to this fact), yet is the pain not real to us, although it is probably real to him. It may, however, be pretence on his side or an hallucination on ours. Pain is only real to us when we ourselves feel it.

Lastly, there are many things which although apparent to the

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[1] "Kritik der reinen Vernunft;" 2nd ed.; pub. by Reclam, Leipzig.

[2] That felt, that of which we are conscious is real.

senses, may not be Kant's 'Ding an sich' at all, that is, 'the thing itself.'

If there actually be such a thing as 'the thing itself,' and eventually what this may be, we shall see later.

For the moment we must hold to my definition of 'real; and in this case we may call, for the present, all that real of which our senses are momentarily conscious.

Another (properly, the first) of Kant's postulates of empirical thought is: "That which agrees (coïncides) with the formal conditions of experience (with respect to the conception and the idea) is **possible**" or, in the original—

> "Was mit den formalen Bedingungen der Erfahrung (der Anschauung und den Begriffen nach) übereinkommt, ist möglich."

Kant is very lax indeed with his choice of words. After using the word 'experience' in its primitive and narrow sense of 'feeling' (*vide* his definition of 'real'), he now uses it in its wider sense with regard to 'conception' and 'idea.' As reason is necessary to conception, his use of the term 'experience' is, in this instance, approximately equivalent to mine. The definition of possibility is therefore, in its present form, inchoate.

When we see—when the sense of sight becomes cognisant of—an object, it is for us real. Thus even an optical illusion is to us real, as long as we regard it as an object which we can observe or otherwise personally feel. Only when we imagine it is that which it but represents, is it an illusion. So, for instance, as a real reflection, a stage ghost is real, for we see it,—it is but an illusion if we conceive of it as a man. If the head be turned aside, the further existence of this object, as such (in as far as no other of the five senses makes its presence known), is possible, but the certainty fails. There may be a natural[1] action of which there is no cognisance, but which has suddenly and noiselessly removed the article, and only when we turn round and see it again, are we *certain* that is exists. It is *possible* —when we cannot conceive of its removal—that it was there all the time, but it *may* even have left and come back again, in which case it was only *probably* there. If, based on experience, there be any

[1] '*Natural*' is the qualification or characteristic which we give to anything (real or abstract) to any force, when we conceive that it in every respect bears that out, which experience, based on reason, has taught us to accept as possible and probable. 'Laws of nature' are a set of probabilities, a compilation of the modes of action which a majority of human beings believe to be those adopted by the forces of the universe. The laws of nature need not be equally accepted by all. One is not forced to accept these laws; that is to say, modes of action apparent and therefore probable to many, may appear illusory and therefore improbable to others.

likelihood, probability, that this could have taken place, then do we conceive the procedure to be natural.

Again, experience teaches us that there are certain other beings, other individuals that can gain experience as we do, and taking our own experience as a criterion, we decide by aid of reason, whether the experience of one group of persons is more reliable for our purposes than those of another group. When therefore we are told by to us reliable people, that there are pigmies in Central Africa, we think it *probable*, and, for want of any other proof, must rest assured that there is a Central Africa, and that pigmies exist therein; but it is not real to us, but only to those persons who were there at the very time of their sojourn. Since Colonel Harrison has come back with his pigmies, we cannot conceive that he would lie as to their origin—it were unreasonable to do so, seeing too that his travels have been followed up step by step—and therefore no other conception being open to us, we must conclude that it is *possible* that pigmies are in Africa. What I have here said with regard to this idea holds good with all our conceptions of the universe. Only after travelling oneself to Africa, and beholding it and its pigmies, is Africa, as a continent, for us a reality. Only after experiencing anything in or of the universe, is that thing whatever it may be for me a reality.

I well agree with Kant when he says that

"Verified possibility is reality."

A third and last example: When a contagious disease is in the same house as that in which one is living, then we know by experience that this sickness is caused by bacteria, that bacteria can move from room to room, and that if these bacteria come into given vital organs, that they there fructify and produce the same ailments. If there be fear of insufficient disinfection or ventilation, then, from this, reason deduces that there is a 'possibility' that I may be similarly contaminated and die. But my thought of death as a 'possibility' is only there when I absolutely cannot conceive of escaping the fatal bacterial attacks.

The ofttimes heard expression, "It is possible but not probable," is misleading, for *all* conditions at any moment being known, only one probability can exist, and every other effect is impossible. Of course what one conceives to be possible, may not be possible at all: my conceptions of possibilities are not the possibilities themselves. The cause or causes of that which can be, or which will take place, are not the same as those whose effect is my conception of those

that may be. I conceive of possibilities by my experience, *i.e.* by what I have felt and feel. Thus, although actually there is only then a possibility of me dying from contagion, when there is really no possibility or, in other words, an impossibility of my escaping, yet can I conceive of a possibility of such death, although I may not in this wise die at all, such conception being influenced by my knowledge of bacteria, the intensity of interest I take in the case, anxiety, pain, or even joy at the idea of dying (which latter is not likely).

All these give actual bodily sensations, and the heart's action varies accordingly, giving changes to particles of the body (irritation)[1] and producing feelings. The interest or anxiety for my own life, my *feeling* for myself, *together with* the presence of the sickness in my house, gave me the possibility of my death.

As we never shall know the universe as it is (the reality)—our knowledge being less than infinity—but only our conception of what it is, so must in every definition (so also in that of possibility and probability) there be the necessary factor 'feeling.' There being in all cases this factor of 'feeling'; it is therefore also in the definition necessary, that in the factor whence feeling originates, those conditions be given which, under an eventual constellation (group of instances), tend to produce a sensation, which is again the basis for a conception. My definitions therefore are:—

A **Probableness** is the result of direct comparison—based on the experience of oneself or others—as to which status under conceived conditions be more in conformity with the laws of nature than another status.

A **Probability** is that which, as the result of the direct comparison of many eventualities—such comparison being under the pre-conceived conditions based on the experience of oneself or/and others—is itself accognised[2] to be a status more in conformity with the laws of nature than another status.

A **Possibleness** is the accognition[3] of a certain status, as being the only one conceivable under certain conditions.

A **Possibility** is, without comparison, the only conceivable status

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[1] *Vide* p. 14.

[2] 'Accognise' a self-coined word, meant by me to describe the expression 'to acknowledge by deductive evidence.' This is very often wrongly given by 're-cognise,' which latter word, on account of its derivation, is often very confusing. On page 14 and so on I wrongly used the word 'recognise' for 'accognise,' but I did so advisedly, for up till then no definition of deduction had been given and also not of deductive evidence.

[3] 'Accognition' is the 'acknowledgment by deductive evidence.'

which the reasoner (wielder of the force of reason) accognises could under given conditions exist.

A possibility becomes a reality, when the conditions conceived become realities.

Here, however, I must expressly warn against the confounding of a probableness with the conception of a probableness, *i.e.* with the conception of what a probableness is, or of confusing a probability with the conception of a probability, or of a possibleness, or of a possibility with the conception of these.

The knowledge which one obtains and seeks to impart to others, can, for the majority, only be a possibility or a probability. It is only a reality to those who have exactly similar experience and feeling, and to others to whom it is at present only a probability, only then real when they have had the same experience and feeling. To a third class of individuals, who have had contrawise experience or/and contrary feeling, our knowledge is not accepted, it is an impossibility or improbability.

As it is hardly conceivable that two persons can, in every respect, have exactly similar experience and feeling, so is it also hardly conceivable that a second person can say that what is real to you is real to him. To demand this striking probability is a sign of narrow-mindedness. We have therefore not to force our opinions upon others, but solely to impart to others our experience, our knowledge, the fruits of our reason, and then leave it to others to cull these or not as they please. If we analyse, we shall probably find that even the most of one's so-called knowledge is not real, but a collection of possibilities and probabilities, the results of our own and other persons' experiences. How then have we the right to force this upon others?

When I accognise that one and the same source always acts in one and the same way on my nervous system, when I re-cognise an effect, and re-cognise that this effect is always from the same cause, then also is the nature of the object fixed, at least, as far as I am concerned.

That to which I have given accognition is part of my knowledge.

Various causes cannot produce the same but only similar effects. X

When the conditions vary, the object is continuously observed under an alterating aspect, and only when this variation either in kind or degree is constant, – that is to say, when these conditions, although varying, repeat perpetually in one and the same order only a given number of variations—can I ascertain the truth. I

But oftimes similar effects are, from insufficient powers of discern
ren to be the same effect. Hence want of knowledge of all the surro
ditions easily misleads us to formulate so-called "laws" which

accognise a certain regularity or constancy, a sort of obedience to a given law or laws in the cerebral functions, in my methods of forming notions, ideas, and conceptions.

Should the conditions vary, but the variations not be constant or repeated, it is impossible to ascertain or determine the true nature of anything. For instance, my jolly student life in Germany has taught me that it is impossible to say how actually beer tastes. Independently of the temperature at which it is served, its taste varies accordingly as it comes to table in glass, metal, stoneware, or wooden vessels. Beer, drank from fairly thick earthenware mugs (as in Munich), imparts to or forces the tongue into an altered and peculiar position, whereby the sensation of taste is partially lost, the tongue receives a feeling of cold, enabling heavier beers to be drunk than would be the case in glass, which latter easily satiates and increases the irritation of the nerves of taste. In wooden vessels, the beer tastes different again. In such a case we make a mental comparison between the several sensations (forms of feeling) and experiences, and draw a mean of the results of such observations. This mean is the greatest probability as to how beer actually tastes, there is no certainty or positiveness. There is yet another way: that of experimenting by letting beer freely drop on the tongue. And even this experiment is not, cannot be perfect. Firstly, much depends on the temperature of the room in which the experiment is to take place, and secondly, on the height from which the liquid is to be dropped. Then again, the carbonic acid gas and the alcohol contained in the beer, by degrees escape before the drops from the containing vessel reach the tongue. The beer is not that which it was. Therefore even experiment does not always put us in possession of the true facts.

Yet this power of wishing to experimentalise is one of the most valuable to us for trying to find out the truth. When we make deductions, there is an after desire to check such mental work, to see if that which we have thought possible is actually as we thought it, to see if, with all means at our disposition, we can repeat, with similar results, actions and things which were formerly completed by forces other than those at our command. If repetition takes place, that conclusion to which we arrived as probable is now conceived as possible. The desire to make experiments seems latent within us. We see it in the first movements in a child's hand to grasp the beam of light that reaches its eye, to feel each thing it sees—it is a part of its character. Yet exactly analysed, only one factor is

'latent.'[1] It is the final resultant of intelligence with those forces which are reflected from every thing[2] around the child. The child sees a ray of light. It wishes to compare the visual sensation received with that of touch on another part of its body. At first it tries to get to the beam, but the body will not move. It tries with the legs, but they will not carry it, and then it tries to touch the object with the hands. Why has it done all this? Simply to find out if the sensation given to the eye is also given to the hand. It finds this is not so. Only much later does the child discover that it sees with the eye, and touches with the hand.

The conditions round about us are constantly varying, but experience has taught me, and perhaps others, that generally even these variations follow some given law, although the instances and times lie so far apart of each other, that it is often difficult to obtain accurate statistics. This is nicely illustrated by Henri de Parville, in the July, 1903, number of the Parisian paper "Debats," who herein tells us of meteorological observations made in the French department Tarn and Garonne in respect to weather prognostications. Here he found, that the six last days of December were a criterion for the weather for the six months to follow, and likewise the six last days of June, a prognostic for the latter six months of the year; *i.e.* the weather of December 26th is similar to that of the entire month of January (the morn, midday, afternoon and evening conforming to the beginning, middle and end of the month), December 27th corresponds to February, December 28th to March, &c., and June 25th to July, June 26th to August, and so on. He was careful, however, to remark that the prognostications were only determinative for the district immediately under observation. With inventions it is similar. Things invented to-day were known centuries ago, that is to say, similar brain actions repeat themselves. If these repetitions be in cycles we do not know. In June, 1903, in Tobermory Bay, Captain Burns of Glasgow, acting under the orders of the Duke of Argyll, while seeking for remnants of the Armada, came across the hull of the 'Admiral of Florence' which Philip II. sent out in 1588, and in which he found a $4\frac{1}{2}$ foot long bronze cannon, which on inspection proved to be a breech-loader,

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[1] Latent to me. Actually or really, there is no such quality as that of being latent. It is an illusion. I cannot here too earnestly impress on the reader, how very important it is to seek to be clear as to what is, and what appears to be.

[2] Under the word 'thing' is here included all that gives sensation, or produces motion, even the forces of light, sound, electricity, and so on, *i.e.* all that which exists, even though it be not so-called matter.

Matter and force as such, are discussed later.

and bears the date 1563. The present generation has, up to now, held that breech-loaders were an invention of the 19th century. In the winter 1903-1904 there were shown at Beni Hasan, on the east bank of the Nile, some 200 miles above Cairo, and later on at Burlington House, London, relics of excavations, among which was a weaving-reed from a woman's grave of the time of Sebek-Hetepa, 2300 B.C., and which is an exact counterpart of the modern weaving-reed as used to-day at Wigan, except that the teeth were of cane instead of steel.[1] Till but within a few years, Archimedes was deemed the first to essay the problem (since 1882 known definitely to be impossible) of squaring the circle. During the reign of King Raaus,[2] a certain Ahnes proposed dividing the diameter into nine parts, eight of which should form the line on which to build the square. Working this out, one obtains $\frac{\text{length of circumference}}{\text{length of diameter}} =$ 3.1604, while π which expresses this ratio, is actually 3.1415 . . . . or a slight error of only 0.02. The papyrus from which the above is an excerpt is a compendium of mathematics, probably a copy of an older work, and either of the date 2000 or 3400 B.C.

As with centuries, so is it with millions of years. The ice periods recur, as far as men can calculate, every 19,000—22,000 years. As either the Sirius or the Vega (α Lyræ) is supposed to be drawing the earth away from the sun at a given rate, the space of time between each ice age will at first diminish till the globe freezes. As it comes nearer and nearer, the Sirius' or Vega's warmth again increases the length between the eras of ice, and after an epoch of constantly increasing heat, our world will roaringly rush with ever-accelerating force into this or that star, or some 'dark' body, and most likely both worlds will resolve in gaseous flames. The wild vortex set up by the mighty blow can draw other stars into the whirl, and thus it were possible that the formation of the starry host began anew. All this is, of course, solely a suppositionary example and very probably does not hold good, if carried to a logical extreme.

Whether the period under observation be long or short, as long as the changings of the condition therein are so rapid or so numerous that a progression of the terms of change and inter-

[1] "The explanation of the presence of models in the tombs is that the Egyptians desired to provide their 'dear departed' with all necessaries in the future life, precisely as their descendants to-day place a coin in the mouth of the corpse to pay the fare of the ferry the dead must cross."

The above extract is from an article in the "Daily Mail."

The idea of a ferry is probably borrowed from that of the Greek Styx.

[2] The above papyrus was translated by Eisenlohr, and contains among other things the description of a beautiful hexagesimal system.

change cannot be overseen or definitely fixed, then must there be, at least as far as we are concerned, a perpetual alteration of our sensations, the more so, as our body is itself constantly changing. The (for our person) constantly differentiating sensations gives us vast opportunities of comparing these.

Accordingly as these more or less suit us, so do we become contented or discontented. We find that some sensations, which were not agreeable, are either ameliorated, reduced, or completely eradicated. Some acts of change are slower in motion than others. It therefore happens that parts of our body which alter or undergo alteration quicker than others, are not equally acceptably influenced by slower functioning outer actions. A perfect harmony of all sensations in all respects is thus an utter impossibility.

In consequence, discontent arises, and from this again emanates a seventh sense: the desire to have something, the desire of possessing, whether that to be had be an object (a table, or money, and so on), an effect of a known force (more light, warmth, and so on), or a subject, an abstraction (rest, peace, joy, &c.).

I will call this seventh sense *the sense of desideration.*

The senses are ofttimes liable to develop at the expense of each other. Thus, fine hearing is found at the cost of loss of 'seeing.' So too, the "sense of desideration" is sometimes seen to enlarge to the detriment of another sense—the 'sense of pain' (*vide* p. 90). An overwhelming predominance of 'desideration' is the origin of greed, avarice, and even kleptomania; whilst want of this sense is the cause of foolish generosity, lavishness, and extravagance.

One can desire to have things or effects of a lesser degree,—to have a smaller or softer object, to have less light (more darkness), less cold (more warmth), and the like. But the sense is not perfectly developed at the first feeling of dissatisfaction. Discontent as regards quantity of light, hardness or softness of objects, are among the first impressions of a child. After the first sensation of touch, the child does not immediately grasp, but uses the fingers, or flat or palm of the hand. The power to grasp comes gradually.

The observation that—

> "The fingers of young children bend upon almost every impression which is made upon the palm of the hand; thus performing the action of grasping in the original automatic manner,"[1]

is not quite accurate. The very first impressions are met with

[1] Hartley, quoted in a footnote to p. 41 of "Mechanism in Thought and Morals," by Oliver Wendell Holmes; pub. Sampson Low, Son & Marston, London, 1871.

distended and not with closing fingers. It is at a later date that the puny fist tends to clench. The knowledge, or rather the child's cognisance of the fact, that it can grasp, combined with its tendency to want something, is the true nativity for the sense of desideration.

It would take us far beyond the scope of this work to fix upon an organ or organs as a special centre for this seventh sense. The foregoing has, however, sufficiently demonstrated that senses are evolved. In years to come, new senses may come into being. Perhaps old ones have been lost. An animal may have senses of which we can form no conception.

To conclude: a fully developed human being has seven senses,—hearing, seeing, smelling, tasting, feeling, muscular sense, and sense of desideration.[1]

Various sensations are characterisations, particularisations, or special graduations of initial feelings, and are often classed according to the forces in which they originate.

The usual notion is, that the conception I have of what the house opposite to me is, is real (to me). My conception of the goodness of my wife is real (to me). The conception of the probable resultants of active forces of not quite known magnitude, *e.g.* my conception of goodness, rapidity (in general), or of the universe outside my exact knowledge, or of the probabilities which would accrue from the falling of the earth into Sirius, is abstract.

This division of conceptions into real and abstract is not exactly to my liking, for we can much better express 'abstract conception' by the one word 'idea.' Strictly therefore,

An **Idea** is that mental impression, either of a future condition[2] which is formed as the result of an intelligent grouping together of various present or/and past experiences, or of past or present conditions which is obtained by the intelligent classification of *past* experiences, or again of *past* conditions by past or present experiences.

I have an idea that a room will look pretty when furnished because

(*a*) I have seen an empty room, or

(*β*) because I see an empty room in the act of being furnished, or

(*γ*) I can imagine how the room in which I am sitting would look if unfurnished.

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[1] Comp. p. 90.

[2] A set or group of force actions.

The first two groups of experiences are those of feelings of pleasure, or gain of comfort; and the last, of experiences of feelings of loss to comfort in the past.

I have the idea that the piece of ice opposite me is cold, because the last time I felt a bit of ice it was cold.

An idea is abstract because it is a probability or possibility only. It is only in the one sense real, that it can influence my further mental action. Thus, if I have an idea that the ice is cold and I do not wish to make my hands cold, I take the ice with a spoon instead of with my fingers. To express what I mean somewhat clearer: an idea is subjectively abstract,—that of which an idea is formed has not necessarily existence—yet objectively, that is to say as an idea, it is real,—but as an idea only.

A **Conception** is that mental impression[1]—true mental image—which one obtains as a result of an intelligent grouping together or classification of various present experiences, the classification taking place by a series of deductions as to which experiences belong together.

A conception is real.

Summing up, a conception is a true mental image of the present only, based on only present experiences. This is never the case with an idea. Thus our true conceptions are very few in number, indeed.

subject of a conception may never-the-less be an abstraction

At the moment of writing the original adumbration of this in pencil, I am reclining in a not very cosy bed at Totteridge, High Wycombe. The only things of which I can form a true conception are a part of myself as far as I can *see and feel* it, *i.e.* my hands, etc., and the rest of myself as far as I only feel it (the rest, excepting my head, being under the bed clothes), the pencil as far as I can see and feel it, the bed as far as I feel it, *i.e.* that part on which I lay (for one does *feel* a village bed), or the foot of the bed which I see, and the room around me as far as I see it.

There are therefore ideas of realities and conceptions of realities.

I have an idea that the foot end of the bed, which is presumably[2] of brass and iron, is cold and hard, for past experience of these metals has shown me that they are so under similar conditions; but I do not know—and the conception is based on true knowledge[2] only—that the brass and iron of my bedstead are cold and hard till

[1] *I.e.* impression of the *mind*, but not necessarily of the *brain*. 'Brain' is a specia part of the body situated in the head, whereas 'mind' is a general term for a thinking organism or system. There are, to my knowledge at least, no directly positive proofs to the contrary, that the ganglia cannot form conceptions,—perhaps even the spinal cord.

[2] As far as I can judge from appearance without direct chemical experiment.

I actually touch them. I do not know, I can form no conception of how my cedar-wood pencil tastes or smells, but from previous experience (direct or indirect) I can form an idea of these sensations. I do know, I can form a conception that I am in a certain house, for I see myself constantly surrounded by its parts since I entered it, but I can only have an idea, amounting to nigh certainty, that the town of High Wycombe is in my vicinity, although it may of course have been burnt down during the night. I do not know what the bed mattress looks like, although I have an idea of it; I have, however, no conception of it save that it resists my weight and of its want of comfort. I can conceive, I have a conception of the bedstead frame as such—for I see its size, shape, and colour—but I can also form ideas about it—of its hardness, temperature, &c. —which, if put to the test by my touching it, would be verified (*i.e. conceptions are verified ideas*); but, at the moment, my senses do not feel the cold or resistance (touch) of the frame, and I can therefore only have an idea of these.

One forms a conception of a thing according to its size, shape, brilliance, *as one sees it*, or/and of its size, shape, consistency, temperature, and other physical properties, *as one feels it*. Such conception of size and shape may of course be false, *i.e.* be an illusion, owing to the distance between object and eye and the medium through which it is seen. Thus of the colour, brilliance, distance, and size of a star one can form an idea but not a conception, and the idea may be probable or improbable to others. These ideas vary with a person's position locally, the state of health (as influencing the organ of sight, though more rarely even affecting feeling), and his or her judgment and reasoning or power of making deductions of these four ideas. Even when one feels and sees, one can be at error, for many things appear and feel alike. Only the true forces producing their effects on us are absolutely real, and these forces we can only gauge, but never know. I conceive force as such, and that is the extent of my absolute knowledge. The rest of our knowledge is relative only. But I must not state but prove.

One can thus, in most if not all cases, have only a very partial conception of even one's nearest surroundings. Oh, how often do we take for conceptions those that are really only ideas!

All human efforts—so also this work—are but expressions of conceptions in the light of relative knowledge.

One can only have conceptions of realities, but ideas both of realities or/and illusions.

If, for instance, I conjure up in my mind the image of a dog, I have the idea of a dog before me; whereas, if I purposely, by mirror reflections, produce the true image of a dog, I have the conception of a dog's image, knowing all the time (of course in the light of relative knowledge), that it is a real illusion to others, who, for their part, have the idea that it is the dog itself. These can conceive it as a life-giving force of given shape and area, but as nought else, and they have no conception of it as a real dog (although they may think so). An image is a true conception, only to those who know it to be an image, for conceptions are based on true knowledge, and our mind's image of the universe is, alas! based more on ideas than conceptions.

And the moral? Think before you act. You must before every action seek to assure yourself as to whether that which is going on before you be conception or an idea only, and if an idea, then all the more reason for weighing the probabilities as to the result of your proposed deed. This by no means leads to non-fulfilment, but only to a slight slowing-down in the otherwise too hasty and impetuous succession of man's movements. I am the very last person to advise "imitating the conduct of the gentleman whose toilet was suspended (Dr. Johnson expressed it less delicately) because he could see no reason for putting on his breeches for giving the preference to either leg."

Now I can make deductions from my experiences and from what I believe to be the experience of others. When *I* obtain the impression that others and I have made on any two or on a given series of experiences, the same deduction, that is to say, the impression that it is not possible for others to have made any other deduction than that made by me, then is that deduction for me —but till others accept it for themselves, for me alone—a '*logical*' deduction.

Of course even herein is only apparent truth, there is a fallacy as in everything human. We can only see and think from our own point of observation. The fallacy lies in the fact that no two things can occupy the same space, and that no two actions occupy exactly within the same space the same time; so that my impression that I and another can make one and the same deduction is false, for the experiences of two persons occupying two spaces cannot be in every respect and aspect similar. This is a very good reason for the practice of tolerance. I can, however, only act under the impressions I receive—I am not completely my own agent.

A conception is therefore then only true for the person conceiving, when the deductions are to him or her real or logical.

To repeat: real logical deductions are requisite to the existence of a true conception. As a true conception is the resultant effect of real logical deductions (the causes), therefore have I the impression of 'necessity' when I think of the connection between the cause or causes requisite to conception and the effect or effects caused.

I have the impression 'Necessity' when I simultaneously think of cause and effect. On the other hand,

when I have the impression 'Possibility' I think of cause without effect; and

when I have the impression 'Reality' I think of effect without cause; therefore can I make the important logical deduction that

All which is real is also necessary.

I have now 'irritation,' 'reality,' 'abstraction,' 'possibility,' 'probability,' 'deduction,' 'experience,' 'conception,' and so on, from which to form my conception of the world, of the universe, and of my place therein. I am therefore in a sequence giving my own conception of the universe. As I receive impressions, as I conceive to have received impressions, so in a like degree do I see, hear, feel, etc. That seen, heard, felt, is for me the world and is for me real. But what is real is necessary, therefore is the world, as I conceive it, necessary to me.

How beautiful this sounds! The world is not useless, but necessary to my very existence.[1] This is no cold philosophy, this is cheering, this is heart-warming truth.

That which gives me my necessities, I like, value, love. I call the giver good and that given me good things.

But who is the giver? Please be patient, dear reader. There is much to explain before you can understand the final answer to this question.

But is this beautiful picture not a phantasmagoria? It is indeed true that what I see and what I hear are to me real, and therefore necessary; but are these things really real? Do these things exist independently of my conception of them? These questions are very important indeed. Schopenhauer declared the world to be

[1] Please note that I do not say that the world is there solely for my benefit: it is very probably just as or more necessary to others. It most probably is far more useful to the universe in general than to us mortals, we mortals being such a small portion of the universe. That this latter aspect is a true one is discussed at length in Chap. IV. of this book.

through and through 'Will,' but that this 'Will' was in itself nought but a conception. If the universe be nothing more than a conception, then is a god or nature, or any cause whatsoever, conception only.

This idea is to me impossible. To a conception it is necessary to have a conceiver. If the conceiver be myself, then am I real, and if there were nothing else as a guide, I should have to say that all else outside myself was conception only.

But if I conceive, I have in me the power to conceive. Then why is it, that I cannot conceive only that which I want to conceive? Why must I often conceive things which, to my momentary conception of them, make me unutterably and utterly miserable and unhappy? This is, however, the case. There must be a force compelling me to conceive in a special direction. This force of compulsion is, however, outside myself, and I am therefore not the only force.

But what is this force of compulsion? In what relationship do I stand to it?

Perhaps taking a few more examples will help us.

I have a book before me. With my eyes I see it, and I touch it with my hands: I conceive that the book is there. Suddenly a bell begins tolling. This tolling bell (or rather this booming of a bell)—a force over which I have no control—so suddenly sets in that I hear, and actually forget (cease) to feel the book, although it is still on the table, as I know for certain, for I still see it before me.[1] My complete conception of the book is interrupted by the bell.

I know from personal experiment and experience, that if I have a slight headache, I can drive it away by sheer force of will. Is it true, that I only conceive the headache and conceive it away again? If so, then with the same right might I say that all sensations felt by me are conceived only, and that the world outside me—so also the book and the tolling bell of the former example—(since it is recognised by my senses) does not exist as such, but is only a creature of my conception. My conception of the world was necessary to me, but it would remain a conception only, and would cease to exist when I ceased to conceive it. But the pain of the headache was not caused by conception only. Brain actions, of whose existence I had no knowledge, were the cause; and these again, forced the brain

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[1] I have, in this case, to thank my knowledge the book exists, to the fact that the force of sight (or rather, the forces causing sight) were stronger than the sensation of feeling which my finger had of the book.

to conceive them. I grant that they are conceived, but they are there independently of the conception of them. True it is, that I conceived the pain, but conception was not the cause of the pain, I felt it against my will.

When I tread on a piece of orange peel which I do not see, and fall and hurt myself, the pain is against my will, for I did not even wish to fall, and the muscles of the leg which relaxed, were compelled to relax independently of brain centres, and the relaxation was caused by the action of the peel on the boot and the boot on the leg, quite independently of the seat of volition—the brain. The force[1] causing pain was without and not within me, it was seemingly against me.

I cannot think of two contradictions at one and the same time. I cannot, for instance, think simultaneously on a poison and its antidote. The conception of the one follows the conception of the other. Just as impossible is it to conceive pain and simultaneously to conceive that I have the will force that will drive the pain away. There are forces acting on and in my head, over which forces I have no control, which coerce me, against my will, to conceive pain—but I cannot conceive the nature of these forces themselves. I then (not simultaneously) conceive I have a will, and will the pain away. But the conception of the will, and the will itself, are distinct forces: the former, by reflex, sets the latter in action. The will (and not the conception of it) acts on the forces causing pain (not the

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[1] These forces from without do not necessarily hurt. They may even cure. Good examples are the employment of anæsthetics, such as opium, chloroform, and so on, which rob one of all thought, of all pain, independently of the will to be free of pain, for many of these can be applied without the knowledge of the patient. Other means are local, such as liquid air or cocaine, which control feeling to given areas of the body.

An interesting example of an exterior agent is coca, much in favour with the American Indians, which limits appetite, and aids protracted exertion and easy respiration.

Yet other forces of nature take away pain. The Professors Redard (of Geneva) and Emery have recently (August, 1904), after three years' research, discovered that light—especially blue light—deadens the thought of pain, although other thought is still active, and teeth have been painlessly extracted by this means. It is, I believe, a well accepted fact by all phrenopathists, psychiatrists, and psychologists, that light and colour have an important influence on the conduct (on the will) of the insane. A dingy or blackly decorated room can, by recalling an unhappy past to memory, make even a lively disposed person melancholy.

Sound again, as in the case of cannon reports, can, against the will, unnerve and shatter the system; whilst music acts assuasively, inspiritingly, invigoratingly irritatingly, or depressingly, in turn, according to the kind and nature of the subject receiving the sounds.

Mesmerism, hypnotism, suggestion, are forces exerted by one human being on another, very often despite his will; and the opposite sex can so influence a person that he or she can be compelled to actions of which they are, under normal conditions, quite incapable. It was once aptly written ("British Weekly" for September, 1904)—

> "The love-letters read in courts of law show that very humble and quite uneducated people can, at a crisis in their lives, write very well indeed."

The man is forced by the powers of love (whatever these may be) to become, *volens nolens*, a mad genius. Teleopathy, or the mutual action of two beings at a distance from each other on each other is a further instance that the will is dependent on exterior influence, coerced to do that which it does.

conception of pain) and by degrees these cease to act in such wise as to cause pain, and consequently can no longer force me to conceive pain. But the forces were nevertheless there. Nay more, the forces may still be there[1] though not acting as before. If therefore, as I trust to prove, force is everywhere, and not only in the head, then are these forces the cause, the origin of our conceptions, and we conceive because we must. Forces would then be necessary to our conception, we ourselves could not conceive (conceptions are in themselves resultants) other things and ourselves without them.

We have learnt that what is real is also necessary. It would then, if forces be everywhere, be equally true that what is necessary is real, i.e. exists independently of my conception of it.

I do not only accognise the world by outer forces, I even accognise myself by the outer component forces of which I myself am the end-resultant. I am not the "All Ich"[2] (myself the omnipresent omnipotent one) of Julius Hart and many modern German theosophists, but a part of the universe—not '*Atma*' but a part of it, acted upon and acting in similar wise to other parts.

Schopenhauer is wrong when he distinctly declares that

"Objekt und Vorstellung das Selbe sind."[3]	"Object and conception are the same."

This he deduces from a former sentence of his:

"Das Objekt aber immer schon das Subjekt voraussetzt: zwischen beiden also kann kein Verhältniss von Grund und Folge sein."[4]	"The subject is a *sine qua non* of the object: there can therefore be no relation of cause and effect between them."

I have shown that what is conceived (the object) is there independently of the conceiver (the subject). But the conceiver is not the cause of the object, but *vice versâ*, the object may be a partial cause of the conceiver. When the conceiver ceases to conceive, he may yet exist. In other words: that which is only imagined, *i.e.* which is imagination only, cannot have the power of imagining that the imaginer has imagined it.

Is this logical? Is it mathematical? Can a resultant have surplus power to overcome (in this case to analyse and conceive) its components? Certainly not, and this is not what is here meant. What I intend this work to prove is: A single force (Will or its

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[1] According to the law of the conservation of energy, no force can be utterly destroyed. Only its form, as recognised by us, has altered.

[2] *Vide* part 3 of the "Neue Gemeinschaft" for February, 1902, p. 97, edited by Heinrich and Julius Hart, published by the "Aktiengesellschaft Nationalzeitung," Berlin W. 66.

[3] "Welt als Wille und Vorstellung," by Schopenhauer, 1. 17, 5th ed., Leipzig, 1879.

[4] *Ibid.* 1. 16.

equivalent) is broken up into its components (forms of energy, attributes of the will or its equivalent). Each component, again, can in itself be itself resultant, and broken up into sub-components (characteristics). Now '*I*' am a resultant of not all, but of certain given characteristics of given energy components. The other characteristic forces of the energy components are then free to act on the resultant 'I' and compel it to conceive More still, I am compelled to conceive in given forms, the forms being themselves fixed by the characteristic forces.

Forces or powers act on us (*vide* p. 40, the footnote thereto, and p. 41). As no two points (localities) can occupy, no two forces act on a single point,[1] so must the several forces, by means of which we conceive the world, occupy different locations, *i.e.* we obtain a conception of space. Even were the two conceptions of will and pain of the latter example simultaneous (which I deny), then since no two forces can act on a point, space is deduced and conceived by two experiences, and it also exists independently of me.

If space exists, it is easy to prove that all else in space exists. The existence of space is not dependent on my conception of it: The conception of space comes later.

But before going any further, I feel I must guard myself against any charge of dogmatism, by seeking to defend my thesis that no two conceptions are simultaneous.

In such a work as the present, only absolute truths are of any service. Seemingly apparent ones and approximations are worthless, as inexactness would lead to serious error and confusion. Thus it were quite misleading to quote from John Jackson's "Ambidexterity; or Two-Handedness and Two-Brainedness"[2] in support of an

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[1] Geometry teaches us, that a point is location without dimension (magnitude). Physics, again, teaches us that two or more forces can act on one and the same point. This, however, can only be true in the sense that only a single force is conceived as the sum or resultant of several forces. Several single forces cannot actually act in different directions on the same point, because in one location, only one force is conceivable—a point having no magnitude, and therefore no surfaces. The laws of physics hold good for so-called 'masses,' but the terms and expressions employed are not always as exact as they should be, and do not hold good if carried to their logical extreme. As it is not mathematical to conceive a point with two surfaces, we cannot have two forces A and B (Fig. 2) acting in opposing directions on a single point C. They can act in the same line (direction without magnitude) only when space or 'mass' lies between. If one force could act directly in a straight line on another equal force without intervening space or mass, motion would cease, life would cease, conception would cease. My notion of nature therefore is, that there is no such thing as perfect contact (motion being eternal). This does not mean to say that no two forces act directly on each other but that one force always acts by induction or indirectly on the other, *i.e.* through the medium of other forces.

Fig. 2.

[2] Published, Kegan Paul, London, 1905.

assertion that two things can be conceived at one and the same time. It is for instance said

> "that there is a latent power or faculty in every sane person to execute two totally different things or acts with his two hands simultaneously ; those acts being mechanical or intelligent."

When I do two or more acts simultaneously, I can only have, at the most, a conception of one of them ; *i.e.* one which is done with the will (or its equivalent) and intelligently, whilst all the other actions are mechanical. When, for instance, I draw with one hand and write numbers with the other, I require two conceptions—one of the thing drawn, and the other of the numbers. The illustrations in the above-named book are therefore for our purpose somewhat misleading, for the two-handed action is not in conception simultaneous but consecutively carried on, and may be, even in execution there are alternations which are so rapid in character that no visible evidence is there. But even if the execution be simultaneous, the pencil or pen may, through impetus, go on moving, although there be no conception thereof, such involuntary movement filling up the minute gap of time between two assertions of will (or its equivalent). There can actually be a continuous action due to unconscious thought on a par with the actions of walking and singing. The singing is conceived consciously, the walking is carried on mechanically, unintelligently. If the numbers, written, say, with the right hand, be added together, then there are three distinct will actions in series, drawing, writing numbers, and adding, which series is repeated over and over again. Sir James Paget once said,—

> "That there were not less than two hundred transmissions of nerve force, to and from the brain, outwards and inwards every second."

Id est, there were a hundred transmissions from the brain per second.

Of course, as I have said, I do not deny that two or more things can be and often are done at once, but then

(1) Either only one of the actions is willed or conceived, whilst the others are mechanical, or

(2) The double action is the result ot one single action of the will.

(1) Thus, when objects are on the table, I may will myself to look at them, and then I will myself to count them. During the time of counting, however, I will myself only to count : the looking at the objects is purely mechanical, depending on the counting, but I have long since ceased to will to look.

One morning early, my brain being at this time of the day the clearest for experiments of this kind, I began counting the loud beating of an alarm clock on the dressing table. When I had counted to about thirty, I started reckoning together how many objects were on the mantelpiece and wall, without, however, giving up my counting of the clock's escapement ticks. Then, apparently without stopping either of these occupations, I began a third one: the comparing of similar numbers, such as fifty-five and five objects, fifty-six ticks and six objects, and so on. The brain was therefore engaged in counting, adding, comparing; which three functions were not brought about by one but by three acts of the will: and these acts, *de facto* were successive and not simultaneous. Involuntarily, but brought about with these three actions, was evidence of a knowledge of location (the making of a distinction between the dressing table and the mantelpiece and between the individual objects). Also involuntary was the recognition of vision (shape) and colour, as also the movement of the eyes from object to object. Besides seeing, I breathed, moved my eyes and other parts of my body, and so on. All these latter actions of the brain were mechanical and not the result of personal will force. I had, at the time, no conception of them.

In the above test, the alarm clock gave 103 double-ticks or backward-and-forward movements of the two pallets per 60 seconds or $\frac{60}{103}$ sec. per double-tick. I counted by the double-ticks. During the counting of 125 such ticks, 19 objects were added together on the mantelpiece and wall. I am aware that I had 125 conceptions that the ticking was taking place on the dressing table and not on the mantelpiece and wall, and eighteen conceptions of distinction of locality between the individual objects to be added. During the same period, I made seven comparisons of numbers, and I know of one conception each, (α) that I should add, (β) that I should compare. I essayed two more series of observation as regards place and colour which were unsuccessful, so can here but register two distinct conceptions that I desired to do more within the time limit, and two that I failed to do so. It must be noted, that when I was making the seven comparisons of numbers, I was not engaged in adding a series of these comparisons together. These were retained in my mind (*without any intention to do so*), and subsequently summed up. But there must be added 125 conceptions of the half-tick, or click of the first pallet, and 125 conceptions that no notice was to be taken of such half-ticks. Thus the total result

was $125+19+125+18+7+2+2+2+125+125=550$ conceptions in $\frac{60}{103}\times 125$ secs., or 0.13239 secs. per conception.

This number recalls to my mind some experiments of which I was the subject. In 1890, i.e. fifteen years ago, I went to Mr. Francis Galton's then existing capital anthropometric laboratory at South Kensington. There, with the aid of a most ingenious device, I had my reaction time for sound twice tested. That is to say, the recording instrument registered the space of time which elapsed between a given clicking sound and my given accognition of the fact, by my pressing a knob on hearing the tone. On the 14th February, 1890, the period was 0.15 sec., and on the 3rd November, 1890, it was 0.13 sec. At these respective dates the reaction time for sight was 0.18 sec. and 0.17 sec. respectively. I am still considering whether or no there be any relationship between the numbers of the bed-room and the laboratory experiments, and if so what this is.

It must be stated that continued exercise, degree of concentration of thought at the time, as also the general state of health, are important determining factors of the result. After much practice on various mornings, *and aided by memory*, I succeeded at last in adding up nine of the same class of objects to the stroke of nine double-ticks. New objects would have taken me considerably longer. To this must be calculated nine conceptions of location between the situation of the clock and the objects, and eight between the objects themselves. There were nine half-ticks and nine conceptions of disregard of such half-ticks. It had been this time premeditated to conceive colour and shape, and I obtained nine conceptions of shape and nine conceptions of colour. I was also aware in four instances that the individual objects had several colours. In all there were $9+9+9+8+9+9+9+9+4=75$ conceptions in $\frac{60}{103}\times 9$ secs. $=0.0699$ secs. per conception.

With yet more effort and exercise, the movement of the pupil of the eye can be taken into account, but I discontinued my experiments at this juncture.

This much has, however, been done. I have conclusively proved that the figures given by Fizeau, namely, that 0.1 sec. is required to transmit an order from the brain to the muscle, and 0.01 sec. for the muscle to get into motion, cannot be correct. The time is self-evidently very much shorter, since I move the pupil of my eye from object to object in this time, and likewise undertake to conceive several things before going from one object to the next. Even the figures 0.13239 and 0.0699 are gross results, and to get the net results,

the times taken to see, to hear, and the time taken before a conception is completed, would have to be taken into account and subtracted. Further research in this direction on the part of competent psychologists would be most valuable. But the main point in the above remarks must not be lost sight of, namely, that there is a sequence of conceptions, and that no two conceptions are absolutely simultaneous, but consecutive.

(2) When a double action is performed, it is the result of a single action of the will, and there is but one conception of such double action. This is best illustrated by the simultaneous movement of one hand upwards and the other downwards. The single action of the will is here, that one hand shall move up and the other down at one and the same time. Thereupon follow either two conceptions—one of the hand going up and the other of the hand going down (the two conceptions being consecutive)—or more often one single conception of a simultaneous up and down action of both hands.

Now to return to our main subject—'Space.' When do we conceive it?

When a child comes from the relatively dark womb to sudden light, it feels this light as a special force until it becomes used to it. But as yet it has no idea of location or space. The child has not yet the characteristic of accognising that 'it is it,' that it exists, that it has dimensions, and that there are dimensions extending beyond itself. It is true, that in the womb it moved. It can be shown that a supply of oxygen to the child in the womb makes it lively; but these actions are reflex actions[1] only, and not a result of feeling.[2] The child accognises nothing, because the light is equally diffused. By the nature of its birth, it is born with certain characteristics (it is controlled by given forces—the resultants of which are automatic and reflex action), one of which is its capacity to move the eye. Dr. Alexander Bruce's[3] definition of "voluntary action" is not quite correct, for he declares these to be caused by impulses originating 'in the nerve-cells in the motor area of the brain,' and

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[1] By reflex action is here meant one directly brought about by the influence of an afferent impulse quite independently of voluntary control. (*Vide* "Chambers' Encyclopædia," art. 'Nervous System.') Many of a child's movements in the womb are not even reflex, but automatic movements.

[2] *Conscious* intelligence, necessary to feeling, does not exist (as far as we are at present concerned) till the child leaves the womb. It becomes conscious (in so far as the consciousness is accognised by us) by the action of forces outside the womb. This is not, however, denying consciousness to the not-born babe, but its existence would have to be proved. It is not to us accognisable, and until something is to us accognisable, we are prone to say, it is non-existent.

[3] *Vide* "Chambers' Encyclopædia," art. 'Nervous System.'

passing 'down the opposite side of the spinal cord to the nerve-cells in its anterior horn. From thence they are transmitted by the efferent nerves to the muscles.'

Now the forces causing, or the impulses of many actions, take this route without being voluntary. I am very often irritable when I cannot at once describe what is in my mind, and actually not only involuntarily, but absolutely against my will, I begin shaking my knee when writing. I know it is a bad habit, and yet I do it. The impulse in this action is along the same nerves as a voluntary action. To a voluntary action, directive intelligence is necessary. A child is not born with directive intelligence,[1] or else it would at once intelligently comprehend all that is going on round about it,—could at once walk, and so on, and have no need to learn by degrees. 'Divine intelligence' is not born with the child.

To repeat my own words: "a child, by nature of its birth, is born with certain characteristics (it is controlled by given forces), one of which is its capacity to move the eye." This characteristic action is not directively intelligent, it is involuntary. There is here no action of the will, but a tendency to act on a given irritation (*vide* footnote [2] to page 23). The rolling of the eye, due probably to excitation of light—the degree of light being never absolutely the same in any two parts of a room—is comparable to the movement of the tentacles round the mouth of an actinea. There is, in this latter, no intelligent movement due to a conception of a mouth to be fed, for essentially the same movement takes place where there is no mouth. Soon an especial light reflected from some object meets the gaze, it accognises that the reflected light gives a certain sensation. As the child has no directive intelligence to fix the gaze, the eye soon involuntarily wanders, and the object (or rather the light from it) is no longer felt (seen). The child begins to accognize that only in a certain position of head can it feel a given light effect; *e.g.* the red colour of a red object. In another position it feels a blue light, and so on. Next, the interimistic medium between the red and the blue and between these and itself is examined, and soon it receives the idea of space outside itself. It is only after an idea of space has occurred to the child that directive intelligence is awakened. It must have very much longer experience before it accognises space within itself.

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[1] Intelligence is for us non-existent till it is to us accognisable. It is only accognisable to us when it is no longer latent as regards the world known to us, but is directive, *i.e.* exhibits comprehensive participation in the world.

A child that cannot see receives the idea of 'space' from sound, taste, or touch, whichever comes first. Could a child neither hear, smell, nor touch outwardly, but could still taste, it would probably only have an idea of itself for a very long time at least. It would have a hungry stomach, and a sequent taste of given food on the tongue would obtain for it the idea of dimension within itself, but not a space outside. Yet would space be around and about the child, although, for want of sufficient senses, it were unable to accognise it.

Kant says :—

"Der Raum ist kein empirischer Begriff der von äusseren Erfahrungen abgezogen worden."

"Space is no empirical idea that is abstracted (deduced) from outer experiences."

I have shown the contrary, namely, that my conception of space is deduced from my experience of outer forces.

Kant says further :—

"Da das, worinnen sich die Empfindungen allein ordnen und in gewisse Form gestellt werden können, nicht selbst wiederum Empfindung sein kann, so ist uns zwar die Materie aller Erscheinung nur *à posteriori* gegeben, die Form derselben aber muss zu ihnen insgesammt im Gemüthe *à priori* bereit liegen, und dahero abgesondert von aller Empfindun können betrachtet werden."[1]

"As that alone wherein which sensations can be ordered and set in certain forms (shape), cannot again itself be sensation, therefore is indeed matter given *à posteriori* to every appearance, but the shape therefore must already lie *à priori* in the nature of them all, and therefore be observed, independently of all sensation."

Now, no object is sensation, whether abstract or concrete; but, being real and independent of us, it is made known to us by the forces it reflects, and these forces give us such ~~sensations that we~~ see the object, but it is not itself 'sensation.'

As sensations are not objects,[2] they have no shape; although it is through their instrumentality that 'shape' is conceived. The objects have shape.

The absolute shape is most probably conceived or sensed by no one, as its appearance varies to us mortals accordingly to the medium through which it is observed. Each person's nerves, each person's point of vision is another; the body itself, through constant radia-

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[1] "Kritik der reinen Vernumft." Reclam, Leipzig, 2nd ed., p. 49.

[2] The word 'object' is here used solely as 'something concrete' and not in antithesis to subject.

tion, the light thrown on it, etc., is continuously although may be slowly changing, and therefore no two persons most likely ever get exactly and absolutely the same impression of an object; though time, place, medium, visual capacity, and so on, generally, for all practical purposes, so nearly coincide that approximately similar impressions of shape can be set up in the minds of otherwise very different individuals, and these therefore are able to agree that a thing is, say, square, round, a cube, a sphere, and the like.

The conception of a shape and the conception of space are two very different conceptions. So too are, on the one hand, the conceptions of 'shape' itself (an abstract abstraction) and of any special shape (a real abstraction), and on the other, the conception 'space' (an abstract abstraction) and the conception of existent space (a real abstraction).

Shape is that attribute that I mentally give to an object, when I mentally describe my limits of sensation of that object.

When I am giddy or tipsy or see the object through another medium, the shape changes. When I am in what one terms a normal condition of health, and look at an object with air as my medium, then is the shape of an object for me fixed. As I above noted, not all people see the same object the same size or shape. Even feeling is ofttimes delusive.

That which contains shape is space, *i.e.* that which contains the forces reflected from all things felt by us. A box can contain a stone. Both can be felt. That, containing forces felt by us, can itself be felt. A stone feels different to a box. I feel space differently from the objects or forces in it, but I can feel it. One feels love. It elates the body, and gives it pleasant sensations. When a letter is received, informing us of the death of one, beloved, we are made aware, by experience, aided by reason, that the words on paper represent events which have taken place. One reasons further, and receives thereby the new impression (the new resultant of a new combination of forces) that a certain amount of pleasure is lost to us, an impression so great (so great a resultant force) that it overcomes the impression (resultant force) of pleasure. This strong impression acts by various currents (direct and induced) causing very complicated reflex and involuntary actions on those parts of the human system which have received loss (may be head, brain, nerves, limbs, or trunk), one feels bodily broken down, and the sensation (as applied to the body) or impression (as applied to the brain) of a loss of pleasure passes along the nerves of these parts, but is not recognised by the brain as coming from or emanating from these, as the forces

act on the eye-nerves (tears), throat, heart, lungs, gall, liver, kidneys, etc., and irritate one or more of these. It is this irritation that the brain immediately accognises and only deduction gives it the conception 'loss of love.' I can feel sudden addition or abstraction of such abstractions. I can feel every ill and every pleasure. I can feel space, for it is that which gives me the pleasure of being able to move. The conception 'space' is obtained from, (*a*) feeling (sensation), (*β*) experience: it is therefore a conception *à posteriori*, and necessary and therefore real.

Space is that which contains all forces known to, and conceived of as possible to us. Space is an attribute of force.

Space can be felt. Although space can be felt, it is like love or hate, an abstraction, a real abstraction. The conception of space is a real abstract conception.

In this I depart from Alfons Bilharz,[1] who says,—

"Die Vorstellung eines *objectiven* Raumes ausser uns, in welcher wir gewöhnt sind mit so grosser Selbstzufriedenheit auszuruhen ist ein reiner Wahn."

"The conception of an *objective* space outside of us, in which we are wont to rest with such great self-satisfaction, is pure madness."

Although an abstraction, space is most decidedly the object and not the subject; for it is, as an abstraction, real.

Peters[2] would raise this real abstraction to a reality. He says word for word,—

"Wodurch haben wir aber die Verknüpfung des Schopenhauer-'schen Idealismus mit seinem Realismus oder der Transscendenz mit der Immanenz erreicht? Doch nur durch die realistische Grundlage unserer Weltanschauung, indem wir dualistisch den unendlich *leeren*[3] Raum *neben* die unendlich volle Schaffensgewalt als zweites Weltprincip hinstellen."

"Whereby have we achieved the interlacing of Schopenhauer's idealism with his realism, or transcendency with immanency? Surely alone through the realistic foundation of our conception of the universe, by placing an infinite *empty* space *side by side with* the infinitely complete (full) creative power (force)."

that is to say, Peters conceives of empty space independently of the conception of it: whereas I can only conceive a force existing independently of my conception of it. This force alone exists (com-

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[1] *Vide* "der heliocentrische Standpunkt der Weltbetrachtung" (p. 114, Stuttgart, 1879).

[2] "Willenswelt und Weltwille," p. 357, by Dr. Carl Peters; pub. Brockhaus, Leipzig, 1883.

[3] The italics are mine.

pare p. 55). This force forces me to conceive the real abstraction 'space.'

I defined space as an attribute of force. Peters too, was on the track; but the fact is, he could not make it perfectly clear to himself. He cannot see the difference between a 'real abstraction' and a 'reality.' He mixes up character or attribute with the object having that character or attribute. In perfect contradiction to the above quotation from his work is another.[1]

"Nun können wir aber in der That raumlose Dinge uns gar nicht vorstellen. Das Kantische 'Ding an sich' z.B. liegt ganz ausserhalb der Grenzen unsers Vorstellungsvermögens. Daraus folgt aber sofort der Kant'sche Schluss: 'Er' (der Raum) wird also als die Bedingung der Möglichkeit der Erscheinungen, und nicht als eine von ihnen abhängende Bestimmung angesehen, und ist eine Vorstellung *à priori*, die nothwendigerweise äusseren Erscheinungen zum Grunde liegt."

"Now actually, we are quite incapable of conceiving spaceless things. E.g. The Kantian 'Thing itself' lies absolutely outside the boundaries of our conceiving-capacity. Therefrom results at once, Kant's conclusion: 'It (space) is therefore looked upon as the condition, of the possibility of appearances and not as a dependent modification of them, and is a conception *à priori*, which of necessity underlies outer appearances.'"

I do not know what Peters meant in my first quotation of his, by "infinitely complete or full." The adjectives "complete" or "full" cannot stand the adverb "infinitely" being prefixed to them.

To show Peters' utter laxity of expression, two more utterances on the self-same page can be quoted. On line 28 he writes, "der unendliche Abglanz" (Eng., the infinite reflection) as if a reflection —a thing with a known cause or beginning—could ever be infinite in its character! In the last two lines, he, who had been describing the infinity of his 'Will' or 'World force,' and his infinity of space, mentions the "nach aussen drängende Willensfülle" (Eng., the outwards pressing fulness of the Will). How can an infinite Will force its way outwardly into empty space? If his force were infinite, would not space have ever been filled? Lastly, how can an infinite space, *i.e.* a space that is everywhere, move outwards? There is infinite movement of infinite force in infinite space. The nearest analogy I can find is an iron ring rotated on a rigid axis, the rotation being caused by induction currents. This ring could move within a space of its own size, without any portion

[1] "Willenswelt und Weltwille," p. 16.

of the space wherein it moved being empty. Of course, even this is only suppositionary and could not actually be carried out in practice; since if there were no free space beyond the wheel, there would be friction between it and the containing apparatus; but I believe the example to be sufficient for the need. Naturally, any other motion than rotary, spiral, and so on, could have gone on in the same space. But you will see that this idea, if carried out to infinity in an infinity of planes, is easier of conception than is Peters' empty space.

On his false hypothesis regarding space and infinity, Peters builds up a very elaborate explanation for the existence of good and evil in this universe. This, to all eternity fiercely waging war between infinity and the space which it has to overcome, he makes answerable for all the miseries and horrors of existence. As, however, as I have shown, infinite space was to all eternity filled with infinite force, no terrific never-ending combat has to take place; and, for the present, there is not only no cause of evil, but no proof of the existence of evil—or for that matter, of good.

Let us not, however, for the moment be carried away by these very interesting speculations, but return to cold, sober logic.

An object (piece of matter) offers resistance to the touch,[1] or sends out rays[1] to the eye. Involuntary notice is taken of where resistance ceases, or from whence no rays are issued. Where rays are not and resistance is not, the object is not—provided of course always that any at present to us—unknown force has not become accognised by us. The limits within which the force of the resistance is felt, and the rays start, is the real object; whilst a line[2] drawn along these limits marks the SHAPE. The conception of 'shape' is a real abstract conception. Of course, without touching, we do not get a true shape but an enlargement of it; as the rays, of whatever nature they be, at once diverge on leaving the real object, and the impression on the retina of the eye is but a magnified image of the original.

Experience is necessary to a conception of shape and therefore *à posteriori*. To have shape, space is necessary. Space also has been shown to be *à posteriori*. In like wise can it be shown, by studying a child's movements, impulses, and thoughts, that the conception of mathematics is *à posteriori* and deduced from its

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[1] It will later on be shown, that this resistance to touch and these rays are in hemselves the object.

[2] A line is a series of points.

impression of outer things and itself. A special form of mathematics is time ; *i.e.* time is a conception *à posteriori.*

As no two conceptions are simultaneously possible, so does a child accognise one outer force or influence before another. The event, for instance, of its feeling red light, and then the event of its feeling blue light, are not simultaneous in occurrence but follow one after the other in time.

Were there no time, all conceptions were at once and not consecutive, and I should, by outer forces, die at the moment of birth—which is impossible.

What can be felt is real; and time can give me pleasure, for when any action is pleasurable, this feeling of pleasure can be enhanced by letting a similar action take place, and this can only take place in time.

What can be felt is not *à priori* but *à posteriori*, and therefore the conception of time is *à posteriori.*

It is a real abstract conception.

A person's conception of time is limited to his experience of the universe ; hence, the conception of time is not similar for all persons.

In like wise, mathematics, geometry, and shape are not alike for all. Some people can believe that 3=1 and 1=3. I cannot believe it. The idea of + (plus) and — (minus) in quadratics is not the same for all, much less so the mathematics of probabilities. Geometry is dependent on shape, and therefore the geometry of a person whose eyes are astigmatical is essentially different from the geometry of a normal person. The conceptions of mathematics and geometry, are abstract abstract conceptions, but of shape, a real abstract conception.

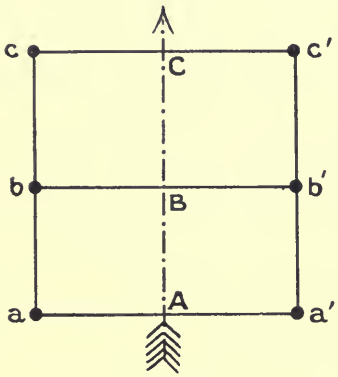

Fig. 3.

Just as an electric current seeks the route of least resistance, so also does the eye of a child, so as not to tire itself, seek that movement which will bring its vision from one object to another in the nearest route. The nearest route is the straight line, but the first conception of a straight line is far more complicated than one would imagine. The child [redacted] at A (Fig. 3) accognises an object *a.* It feels the distance—*i.e.* feels the want of resistance or force of light from the object between the object and itself. The child

compares this distance with an equidistance a' on the other side of itself. This point a' need only be mentally conceived. The conception of equal distances is gained in the first instance from feeling direct (degree of sensation) and then from experience. The next step is to seek other objects or conceive other points, bb' cc', in advance of itself equidistant on both sides of itself, and it conceives itself mentally to be the axis ABC.[1] Mentally the child joins a, b, c, etc. to a line, and then a', b', c', to another line. But not immediately is it accognised that abc and $a'b'c'$ are themselves straight lines. As a fact, these lines are primarily ignored, and only the lines aA, $a'A$, bB, $b'B$, cC, $c'C$, etc., are considered. These are thought of as simultaneously and equally shortening on both sides of the axis ABC till the points a, b, c, etc., on the one hand and a', b', c', on the other, coincide with the axis ABC. This axis is then the first conceived straight line. This line is the first step to the conception of mathematical geometry, for three such lines form a triangle. The idea of crude shape is prior to that of mathematical geometry.

It may be noted here that the organ of 'Static sensation' is, for reasons just given, not developed in the young child. The tendency to stand straight, so ably described by Prof. Titchener[2] is not the first cause of a child's movements, but is, as will be clear, of very much later date, and the functions of this organ or organs are evolved gradually.

A step further. I conceive an object very far off. It may be real, it may be imaginary. In my mind's eye, I draw a straight line from myself to the object. A yet further away object is conceived in the same straight line with the first object, and so on, object and line being repeated alternately in long extension. To this line I cannot conceive an end away from me. It goes on endlessly, but it started with me. I know Sir W. Hamilton brought forward the phrase of "the philosophy of the conditioned" to express the inability of the human mind to conceive or reason respecting the absolute and the Infinite. Against this there is the opposite view of Cousin (a modification of Schelling's doctrine), that

> "the Unconditioned, the Absolute, the Infinite is immediately known in consciousness, and this by difference, plurality, and relation."

I myself find it far easier to think of an infinite straight

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[1] The conception that it itself occupies space, and that therefore an axis can be drawn through its own body, comes very much later.

[2] *Vide* article, 'Static Sensations,' by Prof. E. R. Titchener, of Cornell University in the "Dictionary of Philosophy and Psychology," vol. ii., ed. by J. M. Baldwin," pub. by Macmillan, 1902.

line than a finite one. My conception of points or of shapes (objects) in the line comes to me much later, *i.e.* it comes to me later, that the line is made up of a series of points.

I will proceed graphically. Let X (Fig. 4) be my body and A any point on its confines. Then AA^n is the line, infinite towards A^n. My next conception is a line BB^n, endless towards B^n on the other side of me. Lastly, I mentally join AB and obtain in this wise a conception of an endless or infinite straight line A^nB^n. If I now think such endless straight lines passing in all, *i.e.* in an infinite number of planes through any point within me, I obtain my first conception of infinity.

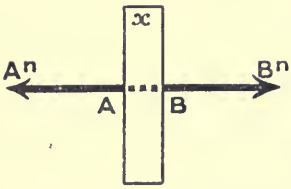

Fig. 4.

The force forcing me to conceive must have an origin or cause. This cause has itself a cause, and so on, each cause becoming in turn the effect of a cause, to which process there is no end. Cause and effect are but relative expressions, *i.e.* used by me to momentarily confine or concentrate my thinking in a given channel. The effect is ever the cause of something else. The object I see has a cause, *i.e.* it is there and owes its existence to some cause,—it is the effect. It causes me to look at it, to note and to describe it. My description influences others, which said influence becomes the effect, and the description the cause. There is force or cause to all infinity, and it is this force or cause which is the cause or origin of my conception (*vide* p. 41). It is the πάντα ῥεῖ—the state of 'flux' and not of 'being' of the old Heraclitus. Can we here not say *Summa causae efficientis causa finalis est?*

As force requires space within which to exert itself (as we have seen), and as the forces are endless in number and no two forces can act in exactly the same space, so must space be endless and infinite. But space has been shown to be a real abstraction, so endless space is a real abstraction and no illusion. As endless space exists, so and in like wise does infinity exist as a real abstraction, for infinity comes to be but another expression for endless space.

Infinity is boundless space.

To repeat:—it is real, although abstract, for I feel it, for where forces or causes, which are the condition [1] of my being, not infinite

[1] 'Condition' is here used in two senses. In the first instance, it is synonymous with 'cause' and is no definite philosophical term. In the second case, it has a clear value of its own as 'attribute.' Force is here the cause and motion the condition or attribute of conception. Motion does not cause conception.

in number and occupied an endless space, I should never have come into existence; I could never have conceived; for motion, which is the condition[1] of conception, would have ceased. Can we not here say *Summa causae efficientis causa finalis est?*

One sees here, however, how different is the first conception of infinity, and the ripe conception of its reality.

There are, alas, clever men like Mr. Cassius J. Keyser,[2] of Columbia University, who, by the masterful employment of logical subtleties, often enough involving well-covered fallacies, seek to prove or to disprove a statement, simply, as it seems to me, for the sake of satisfying their lust for quibble Thus he writes:

> "Hence to *prove*, no matter what, is to *use* infinitude. Hence to try to prove that there is infinitude involves trying to prove that proving is a possible thing. The nature of the circle is evident.",

and seeks to demonstrate thereby, that infinity cannot be proved. To the above gentleman's satisfaction—or dissatisfaction—I trust at last to have shown, that we can *know* what infinity is, and *experience* it on our own persons. We therefore are sure of its existence, though, on account of its character, we never quite can understand it. But if we know infinity is there, there is no necessity to prove it. If, however, as I hope I have done, I have at least proved that we do experience infinity, then have I, indirectly proved the existence thereof. If Mr. Keyser denies this, he at once cuts off all progress, for then were it perfectly worthless to prove anything at all—and his own article in the "Hibbert Journal" also would be worthless.

There is actually no such thing as a point, for, as has been shown, space is everywhere. If space is everywhere, then is there no such thing as a thing of no dimensions. A point is a thing of the imagination, an abstract abstraction, which we mortals, for want of better thinking apparatus, utilise for mathematical and geometrical purposes, just as the chemist has his atom of which 300 millions go to an inch,[3] or the physicist his thousand and more times smaller electrons flying along the cathode rays for the ultimate piece of matter, whereas matter is really divisible as long as it exists as such (*i.e.* as matter).

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[1] *Vide* footnote to p. 55.

[2] *Vide* the art. 'The axiom of Infinity' in the "Hibbert Journal" for April, 1904, and a discussion thereon in the January, 1905, number.

[3] Originally two atoms=one molecule, although a molecule can now have nearly any number of atoms. The space occupied by this molecule, at one time simply mathematical, can now be nearly seen, so that even for the chemist of the future, an atom will not be the smallest particle. This is due to the optical skill of Siedentopf and Zsigmondy, by special illuminating adjustment of the microscope, enabling them to clearly see a square surface, each side measuring 0 000006 of a millimetre, whereas Helmholz reckoned that by aid of blue rays, the smallest visible particle of matter would measure 0.00003175 mm. ($\frac{1}{80000}$ in. according to J. Lubbock) in diameter.

> "About 1,000 have been counted in the hydrogen 'atom;' so that lithium contains some 7000 and uranium 240,000."[1]

I.e. the number increases by multiplying 1,000 by the atomic weight. In like wise, a line (as an endless number of points) is a thing of the imagination : it has no real existence.

> "Geometric law is absolute and abstract, qualifying all things, but nowhere found exact. There can be no geometrically perfect line in nature ; for none is held except against odds."[2]

That is to say, every force is influenced by another. Hence we may deduce, that there never can be an exact counterpart of anything. Conditions are, as has been elsewhere said, continually varying. There will therefore be no perfect circle—no exact repetition of events. Nothing perfectly like that which has taken place in the past will ever occur again.

Like a child, man is contrasted with infinite knowledge, and has, like it, many an imagination and hallucination of realities. Like unto the child, that by degrees finds the real and discriminates between it and the imagination, so can one, when treating of the universe, employ mathematics to explain it, and can speak of a point for want of a more lucid expression; but then one must be clear that the point itself is not real, and has distinctly before him what is real and what is not real, or rather what are the means for the elucidation of the real. But only exact mathematics are employable. Nothing may be eliminated nor neglected. The mathematics of probabilities are quite valueless for finding correct conceptions of the real or existing. Expressions such as $\infty = O$ are misleading, for O is not 0. $2-2=0$ (if one force exactly counteracted another, the resultant would be 0), but $2-2$ is not O. If I have $\frac{1}{x}$ (x being any number) and x becomes infinitely larger, then $\frac{1}{x}$ represents a magnitude infinitely small. But it exists, however small it may be; it is not annihilated; it may differ from 0 as much or as little as I please, but it does differ. This $\frac{1}{x}$ is written O. That is why O never can be 0. As, however, according to the principle herein laid down of the existence of perpetual motion, one force cannot exactly counteract another; there can only be a change in direction and form, and 0 cannot really exist. ∞ is not equal to 0. It cannot even really be equal to 0, for $= \frac{1}{x}$ when x becomes infinitely small,

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[1] *Vide* art. 'The Warp of the World,' by Newman Howard, in the "Hibbert Journal" for January, 1905, p. 287.

[2] *Ibid.* p. 292.

i.e. when $\frac{1}{x}$ represents a magnitude infinitely great. An infinitely small part of anything cannot be equal to an infinitely large part of the same thing. Neither is Leibnitz right when, by means of his theory of infinitesimals, he says that two finite magnitudes are equal if they differ only by an infinitely small magnitude. He is not right, because an infinitely small magnitude may only be neglected in mathematics and the calculation of things mundane. In speaking of the universe nothing can be left out of count, not even magnitudes infinitely small, for they are still magnitudes, and a difference does exist between two magnitudes differing only in infinitely small degree —the two magnitudes will never, even to infinity, be able to annihilate each other.

Force exists to infinity. This has been shown. If force be also eternal, then have I a most important law,—that of 'the Conservation of Energy,'[1] a law which says that the total amount of energy in a system cannot be varied, provided the system neither parts with energy nor receives it; because to infinite force, infinite to all eternity, it were impossible to impart new force or to abstract it. One sees, I hope, how dangerous it were in such questions to approximate.

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[1] When so-called radio-active bodies such as uranium, radium, polonium, &c., were discovered, a great ecstatic frenzy seized upon all religious denominations. "Look ye," cried they,

> "Radio-active bodies have been found, bodies giving off energy of their own, 'yet no loss can be conceived, and this enigmatical material (radium) affords a striking contradiction to one of the primary laws of physics, which is that nobody can part with energy unless it at first received it. Indeed this strange emission of heat by radium "all of its own self"—incessantly and without losing any of its bulk,'"

and so on. (*Vide* art. 'The Discoverers of Radium,' by Frederic Lees, in the October, 1903, number of the "Pall Mall Magazine."

Such outbreaks do not go unchallenged. Heat is a force-form causing certain molecular, atomic, or electronic undulatory motions, which upon our organs of sense give a certain sensation. To this sensation, for want of a better name, we likewise apply the appellation of 'heat.' Carbonic acid gas, when solidified and frozen, burns and leaves a wound and later a cicatrice, in form something like that left by radium on the arm of M. Curie. This solidified carbonic dioxide is, when liberated, in a state of greatest disintegration and gives out heat as well as cold.* Radium atoms too, are in a state of disintegration and give off heat by rapidly showering corpuscles of so-called matter into space, the percussion of which, at the rate of 100,000 miles per second, against other bodies warms them. Warmth is also given to radium by the interior α particles striking others on the exterior, giving 0.5 calory per second or 1800 per hour. According to Mr. Alfred W. Porter, B.Sc. (*vide* "Knowledge" for September, 1905, p. 229), Prof. Rutherford has found that one gramme of radium expels 6.2×10^{10} alpha particles per second at the minimum and 2.5×10^{11} at the maximum radio-activity of radium.

There is no reason for saying that radium gives out heat incessantly. After helium (the alpha ray as described by Rutherford) is hurled off radium, the remainder or emanation is also radio-active, *i.e.* in a state of disintegration.

"It rapidly collapses into other substances and changes into something which is non-radio-active and can therefore be no longer followed."

(From a lecture by Sir Oliver Lodge, 5th January, 1904, at the Town Hall, Birmingham,

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* That cold is not want of heat, can be seen by experiments made by Dr. Spies, of the 'Urania,' Berlin, with liquid air. This lets the warm rays of light through its 200°C. cold body and focusses them as were it a lens, so as to ignite other bodies.

To an infinite number of forces infinite space is necessary. As therefore force is everywhere, I can say that

What is necessary is real,

that is to say, what is for the time being necessary, exists. What is possible and probable will take place and be necessary. As soon

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quoted from the "Daily Telegraph," January 6th.) Radium itself has a life variedly estimated at from 1440 to 3000 years, and is probably a product of the disintegration of some other radio-active body some thousands of years ago (*vide* Dublin address of Prof. Thrift, 1904). Since writing the above, the new and fairly exact calculations of Prof. Rutherford prove nigh conclusively that a gramme of radium breaks up in 2000 years. Mr. F. Soddy has also recently shown, that in all probability radium is a transmutation form from uranium ("Knowledge," September, 1905). Most probably radium will later on be *resolved into forces in no wise acting immediately on our senses*, *i.e.* be no longer matter. This it does by first becoming helium, as was shown when Sir W. Ramsey and Mr. Soddy put radium emanation into an excited vacuum tube and found that it possessed the helium spectrum. Even if the helium spectrum proceeded from helium residue, whilst most of the emanation was radium proper, one would even then not be able to deny loss of bulk to radium by radiation, although it took many hundred years. When we have one kind of gas in a vessel, one can yet, up to a certain limit, put another gas into the same vessel without altering the bulk of the entire. In like wise one gas can be extracted from another without visibly changing its bulk. The atoms of one gas set themselves in the interstices between the atoms of the other gas. So is it possible, that helium gas could leave the radium pores without so appreciably altering the original bulk as to make it known to the senses.

That the atom can resolve into electrons or less we are taught by Poynting's theory. Sir Oliver Lodge well expresses it, by saying electrical energy was put in and comes out again, but Poynting's theorem could be repeated to infinity, *i.e.* the electron cauld disintegrate and so on. It is just as easy to conceive the disintegration going on to such an extent that matter resolves itself into non-material energy.

The terms radiation and radio-activity in relation to certain bodies is therefore misleading. Most bodies disintegrate, *i.e.* radiate and take other forms. The disintegration goes on in most cases so slowly that the force which the disintegrated parts exert is not taken into account. It may not be generally known that nearly all bodies become phosphorescent or light-giving in liquefied air. Only when this force acts in certain ways, such as M. Becquerel found in uranium after five years, does one term it radiation.* Why I do not know. One speaks of invisible light rays! Oh how weak are we in language! Just as well talk of visible heat rays. Many matters extorted fresh from the bowels of the earth have peculiar smells, which after a short time of exposure to the air, cease to exist as such. And then I have in my mind, the finding of the great Russian mammoth. After remaining perfect for thousands of years, it has been brought to the surface and rapidly decayed, giving off powerfully smelling fumes, effective even at a long distance.

Musk (moschus) perfume,† the scent-giving agent of which is but one two thousand-millionth of the weight of the containing fluid, is just as much a radiator as radium, and on account of the fineness of the particles reaching and exciting the olfactory cells, cannot be seen to lose bulk. Dr. Aitken, F.R.S. (*vide* art. "What is scent?" by Dr. J. G. McPherson, F.R.S.E., in "Knowledge" for November, 1905) has found by experiment that these musk particles are finer than dust, for they pass through a quantity of cotton-wool as a gas or vapour (which is one of the most finely divided forms of matter), whereas dust is, by this means, kept back. The same was found to be true of other scents and smell-imparting bodies. Musk, in the apartments of the Empress Josephine in Trianon was radiating (giving aroma, scenting) after forty years. (*Vide* Prof. Buchner's "Licht und Leben," p. 289.)

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* Since writing the above, it has been demonstrated by various authorities that all matter radiates, *i.e.* disintegrates.

† Made essentially from an odoriferous secretion of the musk glands upon the hinder part of the abdomen of the male musk-deer (*Moschus moschiferus*). The fatty secretion of the small follicles under the tail of the musk rat or Russian desman (*Myogale moschata*) also give the desman's skins or furs a musky smell which lasts for years. The substitutes for true musk—the musk plants, *Mimulus moschatus*, *Hibiscus abelmoschus*, (*Ambrette*), and the musk-trees *Moschoxylum schwatzii* and *Guarea grandifolia*, do not give off their perfume for anything like the same length of time.

as it becomes necessary, it will be there, will be real. *All that exists serves a purpose, for it was necessary. That which will take place will be necessary. The universe is not one of chance:* Nor this world of ours, nor that which takes place on it.

> "Every ancient who boiled a kettle must have observed the rush of steam from its spout, but it remained for Watt and Stephenson to adopt it for commerce, manufacture, and transport. And all arts have fared the same. Like spirits in the vasty deep, they wait for their special call. That call is always the same. *It is the deep need of an Age.*"[1]

And our knowledge of the universe? Although there is much of it within our ken, it is not adapted to science, nor used in philosophy to teach the people till "its due season," till it becomes the "deep need of an age." According to Haydn's "Dictionary of Dates," Democritus (about 428 B.C.[2]) taught that the *Via Lactea* consisted of stars. About 480 years later, Manilus (Ov. M. 1, 168), in his astronomicon, as if he had heard nothing of Democritus, sings:—

> "Est via sublimis cœlo manifesta sereno
> Lactea nomen habet, candore notabilis ipso
> . . . . . .
> Anne magis densa stellarum turba corona
> Contexit flammas, et crasso lumine candet
> Et fulgore intet collato clarior orbis?"

Eng. "There is a Way sublime, that in a clear sky doth show,
It has the name of Milk, for its whiteness that all know.
. . . . . .
Isn't it rather a dense crowd, a galaxy of stars
That interweaves their flames and shines with a light intense,
And with gathered brilliance, the ring's light is more immense?"

Yet the Milky Way remained comparatively ignored, till about 1,600 years later Galileo, too, with the aid of the telescope, declared this celestial wreath to be no nebula, but an orbit of myriads of stars. And now? We know at the present moment no more of its functions nor of our relation to it than we did 2,380 years ago. The knowledge is not yet necessary. We cannot even say that information on this subject will ever be useful to and therefore divulged to man. Perhaps it is there to awaken thought. "*Vivere est cogitare.*"[3]

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[1] "My Musical Life," by the Rev. H. R. Haweis, M.A., p. 143 (pub. London, 1896, Longmans, Green & Co.).

[2] The date is more probably 470 B.C. or thereabouts.

[3] Eng., "To live is to think" (Cic. Tusc. 5, 38).

It must not, however, from the above be construed that I say that all that is necessary is there, and that nothing else than the present existing conditions are necessary. On the contrary, that which was necessary need be no longer necessary, and therefore, being no longer necessary, cease to exist. What conditions are permanently, and what are evanescently necessary, what is perpetual, and what is transitory, need not here trouble us. As the series of causes and effects is infinite so also is motion infinite, *i.e.* pervades all space. As two motions (actions of force) cannot simultaneously act in the same space, and as more than one motion does take place in the same space, so are these motions consecutous. The motion being infinite in its action, it must therefore be '*eternal*' (continuous) action. Force therefore being both infinite and eternal, the law of 'the conservation of energy' may be accepted as true.

Motion is eternal, *i.e.* never ceases to be. If motion never ceases to be, eternity must exist. It is necessary for my conception of the universe and therefore real. It is a real abstraction.

Time is to eternity what shape is to space. The sum of all shapes (including that of the gaps between the shapes) is space, and

Eternity *is the sum of all periods, is all-time.*

As eternity is real, so also the parts of it are real; that is to say, 'time' is real, but eternity and time are both real abstractions, and not realities.

Time is the period in eternity during which one or more actions take place.

I have shown that motion is infinite and eternal. Although therefore, for mundane purposes as a rule, I can speak of potential or latent energy in contra-distinction to kinetic energy, yet taken exactly, latent energy is non-existent and kinetic energy alone is.

There are infinitely many forces moving eternally in infinite and eternal space (space must be eternal, or else forces could not move to all eternity), so that an infinite number of resultants are obtainable. Only some few of these are known to us.

There is one thing to be noticed in the definitions that are being here given. To the definitions feeling, thought, reason, experience, conception, and so on, the presence of intelligence was necessary. Without intelligence one can have no comparison. Even the

person called a born idiot[1]—either rightly or wrongly so termed—compares, although the resultants of his comparisons do not lie in the same direction or in the same plane as those of the majority of us. The capacity or power to compare is born with us, and maybe acts already in the mother's womb. It is at all events *à priori* to my conception. We shall therefore, if not now, yet later on, have to face the question, 'What is intelligence and whence is it?'

At present we have found how very difficult, if not impossible, it is, ever to obtain correct conceptions. There is a pretty little popular illustration of this in the "Daily Mail" for February 7th, 1905. The drawing depicts three observations taken at one moment by three separate individuals of a single event in a football match. One saw the ball passed forward, another believed it was passed straight, whilst the third even thought it was thrown backwards. In the article hereunto appended, Prof. Gerald Leighton says:—

> "Truth is invariable, but the Smithate of Truth must always differ from the Brownate of Truth, because Smith differs from Brown in all his powers of perception."

Let me therefore tell the truth of what I see. I have, in the universe before me, veritable realities, abstract realities, real abstractions, and abstract abstractions.

Veritable realities are those things which exist independently of my conception of them, and which, directly or indirectly through the medium of other veritable realities, force me to receive certain definite impressions of them.

Veritable realities are therefore forces compelling me to conceive in a given wise. As they lie in infinity,[2] so can they be viewed from an infinity of positions, and I can therefore never hope to look at them from every aspect. I know of their existence. I can never expect to perfectly understand them.

The sum of these veritable realities (of which we can never know all) is **absolute reality**.

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[1] An idiot, according to us, is a person who sees things in a wrong light, *i.e.* thinks abnormally wrongly. We, the majority, are the judges. According to some, an individual can deem several others to be idiots, *i.e.* according to his experience, every other is suffering from some mania, hate, love, and so on. Now celebrated (generally acknowledged) physicists, discoverers, and inventors were formerly burned as sorcerers by the majority, and it must be borne in mind that all genii are in a minority, and that the works of this minority are appreciated now-a-days often only after death. I want this work to be read during my life. Genii tread paths of their own. These paths were for me too lonesome. It were my desire that the majority build their own thoroughfares and ways of conception by trying to understand the present views of the few, of the handful of philosophers. All must be philosophers, and I will then join company with the majority.

[2] I am forced by them to conceive of their infinity, eternity, etc.; but they may not be infinite or eternal at all.

Abstract realities are those parts of veritable realities as I, from my point of view, am forced to conceive them ; they are those things which I, in virtue of my finality, conceive as real.

My knowledge can only be of abstract realities.

Abstractions are the attributes, impressions, or characteristics which absolute reality, *i.e.* the sum total of veritable realities, force me to have of it or of them.

Real abstractions are those impressions which I receive *viâ* my senses, *i.e.* are those qualities or natural peculiarities of the realities which make themselves known to my senses—which I feel. These characteristics are those which the veritable realities force me to conceive of as existing ; some as long as I live, others before or/and after my demise.

Abstract abstractions are those mental impressions which, apart from my mental conception of them have no real existence. They are what one is forced to imagine—either as realities (veritable or abstract) or attributes of these realities—but which one conceives, *i.e.* is forced to conceive, never could have existed.

Of course they might exist for all that, but we are at present compelled to conceive of their non-existence.

CHAPTER II

MANNAH [1]

WHAT is the universe? What is God? Is there a God, or is God a thing of the imagination only,—a mere abstract conception? What are we?

Usually, to study any subject clearly, it is necessary to start at the beginning; but in this instance it is the beginning for which we were in search. Shall we find it?

In the beginning, so I have been taught, there was peace and goodwill in all the world, and the strong man was a servant to the weak man, and the wolf-(man) lay with the lamb-(man), and each did the other no harm. But I hear others again telling one another that these good times are as yet to come. If these times, as we have learnt, reach unto all eternity, then arises the question, 'was there a time of ultimate good? will a time of ultimate good come?' Sceptics of the present day laugh about a wolf that played with a lamb, and know that no strong man is fool enough to play being servant of the weak one. They do not believe in miracles and wonders, that were a topsy-turvy making of the order of nature, and the order of nature does not admit of being turned upside down.

Of course you must not ask these scientific priests of the holy 'natural order of things,' what that actually is.

At one time these men taught that the sun went round the earth, and they told each other this for several thousand years. But then one morning, not so very long ago, they got up and cried, "Behold, for our earth doth fly around the sun." And in the earlier days one of these men died. Full of horror, the one whispered to the other, "See, a demon, an evil spirit hath sucked of his blood." But quite recently another man lay dead, and the learned brethren took up their lancets and their microscopes, and they cut off, and took out, and examined the dead man's lung and contemplatively raising their heads, thus they sagely spake: "Look ye, he is dead, for bacilli hath

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[1] 'What is it?'

devoured him." And they placed the bacillus in a small vial and they sealed it up,—a bottled sprite. Oh, how very very small hath an evil spirit become!

Ideas have changed, and so has our globe. What was water has become earth, and much that was earth has become water. And fire hath come from the bowels of the earth and eaten her own children.

But may not the changes that take place, may not the infinite and eternal motion of the foregoing chapter be constant in its changes or even constantly change under conditions which vary in specified ratio and directions?

Even if a thing vary constantly, I can comprehend that it formerly had other forms, that it will be for ever changing its forms, and I can yet conceive that it is the present thing, as I see and know it, which is capable of infinite change of form.

That it cannot infinitely change in repetitions of a long series—the series being, however, too long to be mentally grasped—has been sufficiently shown in the foregoing chapter, where it was made evident that owing to the proven perpetual motion, conditions were constantly varying and that therefore the *status quo* of one time could never be the same as that of any time preceding or succeeding.

But if a thing be for ever varying, whether regularly or not, it is yet impossible to know all the infinite forms which it has the capacity of assuming, or which it has assumed. Therefore may I make the contradictory assertions, 'I know what it is' and 'I do not know what it is.' I know that it is a thing infinite, for ever changing; I do not know what it is, for its infinite changes cannot be known to me.

Questions of vital importance have been put. Straight away to say yea or nay were impossible. Preliminary investigation is requisite, and I would therefore beg the reader to be patient with me, if I should offhand seem to be dilating on that which has but little in common with the object of our search. As the archer would express it, we must allow for weight and wind, but following my arrow to the end of its flight, will not, I think, bring us far from the goal.

Very few people, alas, think and act for themselves—autodidacts are rare. All the thinking is left to the few, who are to think for the others. Ask the business man any not all-too-easy question as to the existence of God, and he will—accordingly as he has been either religiously or freely educated—at once send you either to a priest of

God or a priest of science, saying, "I have no time to trouble my head with such questions, I have more to do than that."

Now the true scientist may or may not believe in a god, but it is not his wont to give much time to prove the existence or non-existence of such. He spends his day chiefly in the study of certain laws of nature, that is to say, studies some few attributes of an infinite force; but he takes no heed of the fact of infinity, and regards the world from his petty observation of some few force forms which have been visually or mentally revealed to his gaze. He may even in this wise come to deny the existence of a god. He sees God in his science, and sometimes science is his god. The chemist sees chemical action, the physicist magnetism, electricity, and so on. Of course such investigation is most valuable, for if we had no exact knowledge of the past the whole were for us incomprehensible. And daily are we learning more and more, yet by the virtue of the infinity of the whole we can never learn everything. But, whether heat be caused by addition or subtraction of phlogiston, or is a certain given form of energy, or a sensation on our bodies due to several similarly acting forms of force [friction, concussion, percussion, a wave-like concussion of waves of ether-matter, electricity, or even extreme cold (the effect of solid carbonic gas and so on)], the fact remains that heat exists, give it what name one will. Whence does it ultimately come? To say it was caused by concussion is no sufficient answer, for one then naturally asks 'from where did the concussion come.' Asked at one time what light was, one heard that it was a specified form of energy. Now one is told, that when heat increases to a certain degree, *i.e.* when the ether-waves on the surface of a hot object have increased to a certain number, that then these waves affect the eye-nerves and give light. Of course light, *i.e.* this number of waves per second, is obtainable without heat by fluorescence, phosphorescence, certain electrical conditions, and the like more; but these, we have now learnt, emanate from other to us known forces. We are, thanks to the scientist, on the eve of discovering that all forms of force—either already known or yet to be discovered—emanate in some other form.

The force forms are not independent of each other, but are phases of one another. There are therefore certain things which can be done, certain things which cannot be done. This margin defines the character of the forces of nature, or rather of the one force of which the forces of nature are but several manifestations.

The desire for a happy life after death, combined with fear and

ignorance as to the origin of nature's most imposing phenomena—lightning, thunder, etc.—perhaps mixed with conceptions of dreamland, gave mankind his first idea of a god, a being invisible except in his work. Idols were of later date. As experience grew, the ideas of a god became gradually so complicated that it was necessary for individuals to give a lifetime to the study of this god. As science (the study of that seen and felt by us) grew, so did theology[1] (the study of a god or gods) grow.

At first, that which was not understood, but which he desired to have believed, was taught to the, on such matters, unthinking masses by the priest or theologian to be a fact. It was dogma, and the world believed it.

As individuals joined each other to form communities, it became necessary to protect the weak against the strong. Thus, side by side with the creeds or beliefs in given dogmas, grew up moral or ethical codes. Legal codes (civil and penal) followed. A conception of morality is partially dependent on a conception of the universe. Therefore, to teach the masses a religion (the combination of a creed and a moral code), the god or gods had to be defined.

As one can only explain one thing by comparing it with another already known, so to define what a god was, one took recourse to the study of that seen or felt, *i.e.* science, *i.e.* to that which is a study of single forces or force-forms. This study of single forces is not, however, exact enough to obtain thereby a notion of divinity, for the sum of the obtained results of all the separate sciences is never unity;—a greater or lesser fraction is ever wanting, for the study of one force is ever in advance of the study of the other forces, and the forces are infinite.

The theologian soon notices this need; but for lack of better material, and not wishing to bring himself into disrepute—thus losing his power over the masses—he catches hold of the latest scientific hypotheses, making assertions thereon devoid of every philosophically sound basis. There, where the man of science is making rapid headway, there will the theologian, in the latest solution of any problem, draw the *ultima thule* in this direction. But he is, alas, not alone in his dogmatising. The scientist, who well knows how varied have been the views of men of different ages, who ought to know that he cannot, as individual, know all sides of the question, even he firmly believes that that which experience has

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[1] Or divinity.

taught him must be right,—he takes for granted that the lens through which he observes the universe is the right lens, that he has focussed the lens aright, and what he sees is real:—he, too, dogmatises.

Nowhere does this tendency of the scientist to dogmatise come up more prominently than in the works of Prof. Haeckel:—

"Die Existenz des Aethers oder 'Weltäthers' (Kosmoäthers) als realer Materie ist heute (seit 15 Jahren) **eine positive Thatsache.**"[1]	"The existence of the ether or 'universal ether' (cosmical ether) as real matter is to-day (since 15 years) **a positive fact,**"

he cries, although we have actually gone no further than hypotheses. There are very many, and I among them, who do not believe in the existence of 'real matter' at all, and the phenomenon of light can be otherwise accounted for than by the ether theory. But without a show of proof—not even logical—Haeckel goes on to say:—

"Der Aether ist ebenso unendlich und unermesslich wie der Raum . . . ist die letzte Ursache aller Erscheinungen."[2]	"The ether is just as infinite and immeasurable as space . . . is the last cause of all phenomena."

What put the ether in motion, or is ether a god or divinity?

Often too, through over-great zeal, illusions will crop up, and the scientist will often see what he wants to see, although it may not be there at all. How many of the early physiologists saw in the simple spermatozoon an actual microscopic homunculus with head, body, arms and legs! Why even the painstaking and conscientious Leeuwenhoek was so carried away that he also at first saw heads, arms and legs, and only later did he express any doubt in his having actually seen limbs and trunks of the simple little seed-animals. (*Vide* Büchner's "Licht und Leben.")

Now the scientist has told the theologian that space is filled with particles of matter, the ultimate atom or electron of which is (to him) conceivable and indivisible. These atoms or electrons are ponderable and tangible *dead masses*, in space which is a *void*, or rather a negation of the first two attributes. On this, the theologian bases his latest proof of the existence of a deity capable of ruling despotically the destiny of the universe. His arguments, of the *reductio ad absurdum* class, are as follow:—

'If force and matter are essential to the existence of worlds, then must one of three things be assumed:—

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[1] "Die Welträthsel" (Volks-Ausgabe), p. 91, by Prof. Ernst Haeckel; pub. Bonn, by Emil Strauss, 1903.

[2] "Die Welträthsel," p. 93.

'(*a*) Matter is eternal, and force puts in its appearance within the limitations of time; or

'(*β*) Force and matter are co-eternal;[1] or

'(*γ*) Force is eternal and gave birth to matter.

'If it be true that matter is an eternal dead mass—and by the term "dead" is here signified something without motion—then is there the excessive cynosure of non-motion evolving motion, since force is, in this instance, tantamount to motion. This were absurd. Neither are there any deeper foundations on which to base reliance in Dr. Büchner's asseverations, put forth with a vigour truly eifelesque. If that which has been variedly termed gravity, adhesion, cohesion, etc., had always been in force, particles of matter would ever have been together, and life were not, for lack of motion. Only the last condition,' says the theologian, 'can now be possible. Force is eternal and created matter: *i.e.* there exists a creative force.' This creative force he called 'God.'

The idea is beautiful. At one time—I was twenty years of age—it so attracted me, that, full of romantic enthusiasm, I sought to give it expression in verse. As a guide to the inflexure of mind at that period on my cosmological peregrinations, I give the stanzas which are relevant.

1. "It hath been said that 'chance doth rule; the Lord doth not exist;'
By those who know not well God's works; and thus distort and twist
A truth that may not be denied by any thinking man,
Nor to conceive, doth it require imagination's span.

2. "'Force, without matter, could not be,'—some great wise men have said;
And this peculiar statement to wondrous results led.
For if matter eternal was, and force came to its aid,
Then force e'en owed existence to, and was by matter made.
Could such a thought be long conceived, or harboured for an hour?
A dead mass wakened into life, without some primal power!

3. "'Force and matter did co-exist,' Professor Büchner[2] said.
Can this be uttered by a one, who much has thought and read?
Would atoms, throughout boundless space, *have kept apart* at all?
Attractive force had *done* its work, and made for *aye* our ball.

4. "Creative force has ever been; and it gave matter birth.
Attractive force was added then; and so was made our earth:
For atoms *kept apart* awhile, till marshalled by God's will;
Nor till command, together rushed, and did his work fulfil.

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[1] *Vide* Dr. Büchner's "Kraft und Stoff."

[2] *Ibid.*

5. "With speed those atoms whirled and twirled, and eddied round and round;
And through unknown infinity vibrated the first sound,
Heat evolved; and glowed; and toiled; exerted mighty power;
And as it burst its every bond, masses in a shower
Were hurtled into boundless space, yet could not go afar.
Some fragments did control the rest, and each was sun or star.
Each gaseous and glowing part,—still giddy with the blow,—
Though forced in circled course to fly, reeled on its axis, slow.
But it were vain, through ethered space, each complex path to trace;
Rather, let us join our so-called 'earth' in her mystic race.

6. "A while she fretted, fumed, and roared; and whirled and twirled about:
Until two gases compact made to put her fire out.
For Combustion's supporter, and the Heat-giver too,
With a flash joined together, hiding all else from view.

7. "Then the Earth raised her rocks;—she was eager for fame;—
And the Water strove with her to win him a name.
And the Earth with the Water did wage a great war;
Until both of them wearied, declared it a draw.
It was soon after this, that the Water with Earth
Did join in embrace: to living beings gave birth.
Fish and beast, reptile and fowl,
Came forth breathing from Earth's bowel.

8. "Ne'er a stranger host was seen!
Nature ruled them all, as queen.
Vegetation grew and flourished—
By this wondrous Water nourished.
When the whole had grown apace,
Came, at length, the human race;
Better formed than all the rest;
By Almighty extra blest."

During life much must be learned, much unlearned; but it is often far wiser to unlearn than to learn. Sir Thomas Browne aptly expressed this sentiment when he said that—

> "Knowledge is made by oblivion, and to purchase a clear and warrantable body of truth, we must forget and part with much we know."

How shall we learn with what part of our knowledge to sever? By the use of our reason; and Claudian has told us that—

> "Reason is the glory of human nature. He is next to the Gods, whom reason, and not passion impels."

To be an eclectic, one must be a reasoner; and the less one is of the eclectic, the more narrow-minded, dogmatical, bigoted, fanatical must one be: for no system conceived by man at any era whatsoever of his existence can be perfect. He therefore is colour-blind who thinks to see all good in his own, no good in another's system.

What is there faulty in the system of the theologian? Are his ideas or conceptions of matter true? Is matter a dead mass, *i.e.* without motion? Is it actually and absolutely any more concrete than any other parts of space—the theologian's void? Is the ultimate atom or electron conceivable and indivisible? Is matter itself spiritless? Is space a void? Is there a creative force?

Certainly the atomic theory has its history. Its founder may be said to be Leucippus, born at Abdera, in Thrace; and whose teaching made a great impression at the beginning of the sixth century B.C. His conceptions are the practical emanations of the early hylozoistic[1] philosophemes of the Grecian Ionic school; and he taught that the original characteristics of matter were *quantitative*, not *qualitative*. Democritus, born, strange to say, in the same town, but a little more than a century later, held, expounded, and enlarged on the same philosophy. To the atom he gave a primary motion independent of any higher principle. The multitudinous combinations of this motion produced the aggregate which we call *nature*. Democritus acknowledged *law*, not *design* in nature. "The word 'chance,'" said he, "is only an expression of human ignorance." 'The Philosophers of the Garden' and their good-natured and contented instructor[2] held views closely homologous with those of the two sages of Abdera. With many links, we come at length to the chief expounder of modern times in the person of the illustrious French mathematician and philosopher Père Gassandi, born 1592, at Champtercier, a village of Provence; and who, in 1649, wrote his "*Syntagma Philosophiæ Epicureæ*," by which he gained for himself the hegemony of the philosophers of the atomic school.

Although, as you see, the atom has such noble supporters, I am afraid that it is an impostor, the hippogriff of science. The existence of an indivisible atom or yet smaller particle of matter were contrary to what we have learnt in Chapter I. We found that space was not a void, but filled with infinite force in eternal motion. If this be so, then as motion is everywhere, a dead

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[1] Postulating animated or living matter: Hylozoism.

[2] Epicurus, born at Samos, B.C. 341. He taught in a garden at Athens B.C. 307, and hence the name of his followers.

mass could be nowhere. Of course the conception of an atom is valuable to us for mathematical purposes, but it is a hindrance to philosophic work.

But you will say to me, "Your philosophy must have a fallacy, although I have not yet found it, for matter does exist, I see it, I feel it, I myself am matter."

I do not believe there is a conception of science about which more gratuitous assumptions have been made than about matter.

The celebrated Newton, because he discovered the force of gravity, has been held an authority on all points. His definitions have become the axioms of the scientists of to-day. Let me examine one of them. He defined *mass* as the *quantity of matter* in a body. As every one believed he knew what mass was, and as nobody then knew of a plausible theory (much less a proof) to explain what matter was, he advanced no further than before.

The well-known mathematician, Prof. Pearson,[1] seems to think that 'matter' is—

> "a popular superstition which has forced itself upon physical science, much as the popular, or, at least, theological superstition of 'soul' has forced itself upon mental science."

It seems nigh ecumenic to fancy 'matter' tactile, ponderable, and indivisible. An evident corollary hereto is to declare matter to offer resistance. Resistance is force. Then matter is that which exerts force. This statement also is somewhat homonymous before we know what force is. I think the best definition I can give is, that—

Force is the producer of motion.[2]

Of course it is an open question to deduce from this, either that various kinds of motion are producible by various kinds of force, or that all motions are the result of one force.

A corollary to a corollary is admissible. One, to the statement that matter offers resistance, is that matter is made known to me by the senses. Therefore the physical sensation of feeling is a production of matter. This physical sensation is, however, due to motion in- or ex-ternal, so that matter becomes the producer of motion. But that which produces motion is force (*vide* the above definition). Then as matter produces motion, therefore

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[1] Karl Pearson, M.A., Professor of Mathematics at the University College, London, to whom my thanks are due for many of the ideas on this subject herein expressed.

[2] 'MOTION' is change of location. This primary notion of location is of course arbitrary, but natheless necessary to mundane logic.

must *matter be force.* This but substantiates the deduction of Chapter i. that force alone is.

This is rather different to Prof. Pearson's sophistic quillet that 'force is a description of motion' and his further philosophic quirk that 'matter is that which moves.'[1]

For all that, I think, to a certain extent, our inferences formed from the above are very similar. 'There are many roads leading to Rome.' What some of these inferences are, are best left to another chapter.

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[1] *Vide* Prof. Pearson's discourse on 'Matter and Soul,' delivered before the 'Sunday Lecture Society,' December 6th, 1885.

CHAPTER III

GENESIS

ALTHOUGH many somewhat similar results to those just obtained, have comparatively recently become known to the few thinkers, yet are they startling enough to the novice in such topics and for that matter to the public generally, being very far from the present popular notions.

When the masses accognise that matter is force and force alone is, the fact of its being known can be anything but pleasing to the priesthood. The internecine effect on the theurgy of the theologians is at once apparent.

There are very few terms exactly applicable to these new conceptions, and those existing are confusing. For convenience, I will still call the seemingly inert forces 'matter,' and the forces to overcome this apparent inertia 'force.' The expressions 'seemingly' and 'apparent' are advisedly used, for we have seen that motion is eternal (*vide* p. 61).

The quoin is now set for building up a synopsis of the whole working forces of nature.

> "Give me matter and I will create the world,"

was the mere boast of Kant; for matter being granted, not much universe is left to be explained. René Descartes, great geometrician as he was, cried—

> "Give me extension and motion, and I will construct the world."

Although far from following his philosophy *in toto*, there is much to be said in favour of this view of the moving thing. That all matter is shape, and yet not of necessity shape filled with anything, comes very nigh some of my own hypotheses (*vide* p. 52).

A hypothesis of matter which has exerted a verily moliminous effect on scientific theory—one which denied it even extension—is that of Roger Boscovitch.[1] It concedes to the ultimate elements of

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[1] *Vide* his "*Theoria philosophiæ naturalis redacta ad unicam legem virium in natura existentium.*" Strange is it that two such men as Descartes and Boscovitch were both educated at Jesuit colleges.

matter nought but the idea of mathematical points, *i.e.* points devoid of extension. This has been shown (*vide* pp. 42 and 56) to be impossible. Matter, as known to us, does occupy space, but no amount of mathematical points, however great, can take up room. Dimensionless things are roomless. Bearing however in mind, that our conception of matter is that which causes motion, *i.e.* force, the universe of Boscovitch can be amended, inasmuch as it can be conceived to be made up of an infinite number of mathematically dimensionable and movable centres of force. In popular parlance, a group of such resistance-offering centres would form a shape, *i.e.* a body consisting of centres of force.

To the smallest conceivable shape of definite dimensions, as time went on, several names were one after the other applied; primary particle, molecule, atom, ion, electron, and the like more. This smallest conceivable shape is not, however, really the usually so-termed 'ultimately smallest particle'; for, as can be easily accognised, by nature of its being, matter can have no ultimate particle. When the centres of force cease to any longer group themselves together in such wise as to form matter, matter will cease to have existed; force, as we know it, as dynamic energy, will alone remain.

I can say to-day, "**Give me but force capable of changing its modes, and I will explain the universe to you.**"

This expression is no '*Kant*,' for we know the signification of force. Force is the producer of motion (*vide* p. 72), and can take both the form of matter (force in seeming inertia) or of dynamic force—and this to infinity to all eternity.

When Newton was discussing gravity, he declared it might be due to diminution of pressure in a fluid filling space in the neighbourhood of material bodies. In so saying, he unwittingly followed in the time-worn footmarks of Manu, for in the "Old Indian Institutes" of Manu are found an enumeration of the five elements, fire, water, earth, air, and *subtle ether*. But the Indian sage was soon forgotten, and Newton too.

It is only comparatively recently that inventors have brought forward many so-called media, among the most noticeable of which are the ponderable ether of Prof. Dubois Reymond,[1] of which there is one pound to every 1,000 cubic miles of air, and the ether of Geheimrath Prof. Paalzow,[2] of which there is $\frac{1}{10^{24}}$ of a pound to a

[1] Professor of Physiology at the Berlin University. Born 1818.

[2] Professor of Physics at the Polytechnic High School, Charlottenburg. Born 1823. Austere, but lovable and loyal. Since I was his pupil, I renewed the acquaintanceship after I married, and found him a good friend and pleasant talker.

cubic mile. Lord Kelvin,[1] however, came nearer to our conception, when he founded his idea of an intangible ether in which a certain vortex movement is conceived by him to be matter.[2] The vortex ring was chosen, because he, like von Helmholz, demonstrated that in a certain kind of fluid (a frictionless plenum), such a motion once started is as indestructible as the Lucretian atom, and yet capable of vibration. Not to be deemed partial, it is only right to mention Prof. Clifford's mystic complex labyrinthine system of space inflexures drawn from the analogy of the wire, the worm and the tube. It was never perfectly worked out, and never required to be, for it would have necessitated the granting of the existence of an impossible shape of four dimensions, for otherwise we could not conceive a bend in our own space. The very idea of a universe outside our universe is an absurdity. And yet, unknown to them-

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[1] Better known as Sir William Thomson, Professor at the University, Glasgow. Born 1824.

[2] Lord Kelvin, at an earlier date, showed that the diminution of pressure mentioned by Newton, could be accounted for if each particle of matter were—

> "a source at which an incompressible fluid is being constantly created at a rate proportional to the mass of the particle, the fluid being also constantly annihilated at an infinite distance. Or, conversely, that the fluid is created at infinity, and absorbed and annihilated at each particle at a rate proportional to its mass."

Hydrodynamics teach us this simpler in that,

> "in a fluid the pressure is least where the speed of motion is greatest."

Vide art. 'Ether,' in "Chambers' Encyclopædia."

If, as we have seen, a particle of matter be nought but a group of force centres (it may be Lord Kelvin's vortex motion or any other) then were it possible to conceive of forces resulting from the matter-forming forces, and forming (not creating) for themselves an incompressible fluid. This cannot, however, help Lord Kelvin much, for the idea of a fluid being annihilated at an infinite distance is impossible save as a mathematical curiosum. Annihilation of a fluid, *i.e.* of matter, is possible without cessation of motion (p. 75), but annihilation takes place within time, within a definite distance. To conceive the contrary would involve us in a similar fallacy to that which is expressed by $\infty = 0$ (*vide* p. 57). In fact, Lord Kelvin's ether may be an interesting theory, but it does not bear out facts. When he says that it has negative compressibility and is made stable by virtue of its infinity, he draws the conclusion that—

> "the speed of propagation of the condensational-rarefractional wave is zero."

This is tantamount to saying that it does not exist. But the condensational-rarefractional wave does exist, as in the case of sound in air. Therefore the ether were outside the air. In the electro-magnetic theory (Maxwell's, Herz's, etc.) this wave is got rid of by means of the reverse mathematical quibble, namely, by assuming its velocity to be infinite. Now a progression or acceleration of motion from locality to locality in space is thinkable. I can even form the idea of an infinite acceleration in infinite space (I do not, however, conceive it probable), but in time, there is a given acceleration, and therefore at no moment is the velocity infinite. As at no moment is the velocity infinite, so at no moment is the electro-magnetic theory exactly true, and therefore at no moment can the condensational-rarefractional wave be got rid of. Lastly, the ether fluid as above must be frictionless, or else there were viscosity. Now viscosity does exist. But where the vortex motion does not exist, it never can exist (Helmholz),* therefore viscosity existing, the vortex could not exist where viscosity is. The vortex action *ad infinitum* is impossible; it leaves no play room for other forces. Even the idea of a frictionless medium is impossible, for force acts on force (cause and effect), and this action is, in its character, similar to friction.

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* Professor of Physics at the Berlin University. Born 1821. For his theory of vortex motion, *vide* "Crelle's Journal."

selves, many give expression to four-dimensiona ideas. Peters,[1] in a criticism on Schopenhauerianism, says :—

"Somit involvirt der Schopenhauer'sche Gedanke, wenn auch unausgesprochen, ohne Frage die alte Wahrheit eines ausserweltlichen Wollens, dem alle diese inweltlichen Naturkräfte ihre Erscheinung oder ihr Entstehen verdanken."

"Thus, although unspoken, the Schopenhauer conception without doubt involves the old truth of a Will (Volition) external to the universe, to whom all natural powers within the universe owe thanks for their existence."

Firstly, a universe outside the universe is to me inconceivable. Secondly, Schopenhauer was the very last person to give expression to such an idea. Schopenhauer (not accepted by me in very many things) declares that there is a Will, and that this Will alone is. This Will conceives conceptions which it terms abstractions, it conceives conceptions which it declares real, but neither do abstractions nor realities exist except as a conception of the Will. Intelligence is also, according to him, solely a conception of the Will. When Schopenhauer discusses things realistic, he solely discusses a certain class of conceptions of the Will. The Will of Schopenhauer is not outside the universe, for according to him, the universe is a conception only, the only reality being the Will, a conceiving Will, but not an otherwise acting force.

From all these theories of matter, one fact stands out prominently: there is a common feature in them all. Like myself, one and all have endeavoured to explain away the obscure idea 'matter' by something more lucid—to notions of force, motion, and shape. The ultimate element of matter, non-existent, is therefore entirely outside the range of experiment; and it is self-evident that these theories of matter are really essays to explain our sensations by reducing them to force, motion, and extension, categories of which we can form clear conceptions. The sensible universe is, for us, built up of force: the force to our senses, producing what we term motion; and the observations of the manner in which one force acts on another to produce this idea of motion to our senses enables us to lay down 'laws' of force, by means of which all manner of physical phenomena can be rendered intelligible. We obtain the *noumina*. Theories of matter are simply efforts to systematically express and clearly define the seemingly different kinds of force

[1] "Willenswelt und Weltwille," by Carl Peters, p. 124. Pub. F. A. Brockhaus, Leipzig.

which bodies produce on each other, to explain the effect of force on force.

No definition of matter can be accounted satisfactory, or at least a final solution, which only reduces one sort of matter to another. A perfect fluid, *i.e.* one without particles, is inconceivable. When I here write 'particles,' of course I mean such made up of centres of force. A fluid without force centres were motionless. Even were the vortex ring matter, there where the matter is, the fluid is no longer of one consistency with the outside-lying fluid. What are the influences at work to set such a fluid in motion? The fact of the infeasibility of explaining matter by matter, to deduce the laws which control force from bodies which themselves obey the laws of force, has not always been clearly accognised. And it were no actual explanation of gravitation and cohesion, to deduce them from the force or forces of an ether, which would again necessitate me explaining how these forces were started. Another ether might be invented for the purpose, but where, pray, is this series to stop? It somewhat ludicrously reminds me of a naughty little rhyme I once heard as a schoolboy:

"Big fleas have little fleas
Upon their backs to bite them;
Little fleas have smaller fleas,
And so *ad infinitum*."

The schoolboys evidently thought this series a possible one. Just as possible is it, dear readers, to conceive of an infinity of ether media.

Many of the laws (characteristics) of force are of the nature of matter, though not necessarily all; but none of these laws can themselves define matter. Hence, if we explain our atom by the laws of force, we may have gone back a useful and necessary stage, but we have by no means explained the nature of an ultimate element of matter.

Is there not some crudely conceivable roughly workable synthesis? Let us try if the graphic method can help us.

What is that object before me, the visual resultant of which is accognised as the surface *BD*?

Let *g* represent the direction of action of a very great number of forces working in the same or in various planes, all under the influence of a common system. It is here not necessary to go into the magnitude of these forces. By a vast controlling system of forces, which we will collectively call *z* (not shown in the Fig.), the

forces g are not only guided in their direction, but may be broken up into the component parts h and k and the series of local centres e where the forces are broken up, are distributed along the four straight lines AB, BC, CD, DA, which form the shape or figure, *i.e.* the contours of the surface $ABCD$. These local centres of force distribution are so close to each other that the human eye is insensible of the intermittent spaces. The entire area AD can also be considered as made up of such force centres e. In like manner, the force k may be conceived as made up of so and so many energy centres from which energy radiates in one or more directions, one of which I have arbitrarily drawn as f.[1] There is now a whole complex of forces all working in perfect harmony. Now by

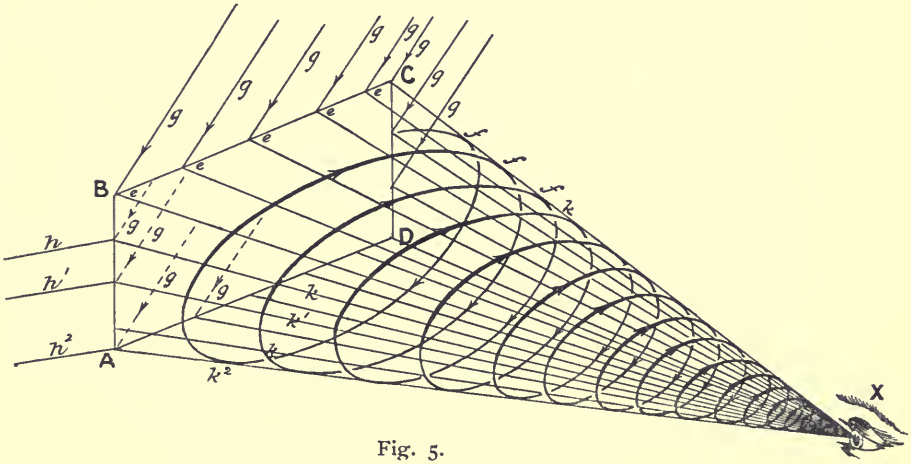

Fig. 5.

means of the controlling system Z, all the resultant forces k can be made to converge towards a common centre x, which may be the human eye, the ear, a muscle or nerve, or any part of a sensitive system. *E.g.* Here is a copper wire. A part of the controlling system Z—the controlling force m (cohesion) is keeping the particles, atoms, or groups of force centres of which such atoms are composed, together. The centres themselves are composed of forces g, of which a component k meets my eye, acts on its nerve, and by means of that which we have learnt to be the sense of sight, tells me of the existence of this wire.

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[1] f is here forced by Z to move in waves of circles, or as ovals, spirals, vortices or the like, or combinations of these, or in any way in conformity with the laws of nature, *i.e.* with the characteristics of the all-pervading controlling system Z.

The forces *g* throw back very many forces reaching them from other pieces of matter or conglomeration of forces. According to that thrown back or reflected, and in what manner the same is performed, does the eye obtain the impressions of colour. Take for granted that the reflected forces, giving the impression of colour, can be influenced by the movement and nature of *f*. Then if *f* be influenced, the colour will change. Let such a force *l* (one of the system *Z*) in such wise act that what we term electric current or motion is set up in the wire. As soon as this electric motion reaches to a hundred million million vibrations per second, we have warmth, and soon after, with increase of the vibrations,[1] change of colour. This change of colour, representing 450 billion ether vibrations per second, goes on till the original dark copper colour of the wire changes to red at 480 billions, and to yellow at 540 billions; when, by yet greater speed, a dazzling bright light is the result. If *l* sufficiently influence *f*, the movement in the wire becomes so great that *m* (cohesion) is overcome, and such disintegration of the force groups sets in, that after the wire liquefying (melting), it becomes gaseous, *i.e.* the wire has become broken up into particles to which we arbitrarily assign the size of molecules. These are of course, too small (too weak) to be seen (felt) by the eye, and a good part of the force *k* from one molecule is annihilated by the rapid motion *l* of another molecule, long before it can reach the eye. It is now easily conceivable, that the forces forming a molecule be so disintegrated that they cease altogether to exist as molecule, atom, electron, or group, each force therefore acting for itself. Matter, as such, ceases to exist: force alone remains.

This is a simple way to get one to understand that all matter is radio-active, *i.e.* that all bodies, having once been born, again die—disintegrate. There is always a certain amount of electricity in the air, brought about by heat, cohesion, or other causes. The atoms of those bodies therefore, which can in any wise be electrically charged or influenced (and that, according to my idea, includes all

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[1] The "undulatory theory of light" was first set forth by Christian Huygens—a friend of Spinoza—about 200 years ago. The Kathode or electronic rays have, however, taught us to be careful in accepting this theory. The truth may lie between the old and new notions of light, *i.e.* some light may be due to vibration, other light to the action of minute projectiles (electrons); or again all light may be the result of material ejection in such wise that, in the present state of our science, these particles cannot in every case be ascertained and fixed. Becquerel, in the "Comptes rendus," makes mention that the radio-active bodies—radium, etc.—emit alpha rays which are also in slight degree deflected by a magnet although in an opposite direction to the Kathode rays, *i.e.* are probably material. As, recently, Mendel, Prof. J. Thomson and others have shown that most likely all bodies are radio-active, may not colour be the effect on our eyes of these rays of matter?

bodies), are open to disintegration—to decay. Such bodies give off various kinds of rays, such as, α, β, γ, X, N, and many another to us unknown, according to the nature, strength and conditions underlying the electric charge.

The colour of objects may be partially due to radio-activity. The particles may even radiate in a given direction. This can be easily experimentally shown, by one putting each hand about an inch from the ends of any small *oblong* table, when one hand feels cooler than the other, owing probably to some emission from the table end.

Whether radio-active bodies radiate—as suggested by Sir Oliver Lodge—

> "Because of the radial acceleration of the revolving charge, and therefore the charge must be approaching the centre of the atom and its velocity be ultimately increasing, until when it approaches the velocity of light an unstable state of things must ensue . . . . or whether, amid the vicissitudes of a varied career, from collisions with their fellows occurring at times, in such a way as to increase the velocities of some of the atoms beyond the ordinary limits at which their state is stable, or whether from a concurrence of both forces or whether in some way not yet understood . . ."[1]

is still *sub judice*.

In certain metals such as radium and uranium, even the speed of disintegration of the atoms into electrons has been calculated by Prof. Rutherford and others.[2] It may not be long before we shall be able to calculate the speed and force of the disintegration of electrons, *i.e.*, to fix the laws of dematerialisation.

I have above shown but one way of influencing *f*. That *f*, as also *g*, *h*, and so on, are open to the attack of forces at all times, and thus give us varied notions of the colour of objects, can be seen from the report for the year 1905 of the Indian Geological Survey Department, which makes mention that the clear variety of the seldom-found mineral sodalite becomes a bright pink when kept for a short period in the dark, regaining its original appearance after again coming to the light. A living creature, the chamaeleon, changes the colour of its tuberculated skin through the disposition and expansion of the underlying yellow and very dark brown pigment-containing cells being emotionally—nervously, *i.e.* electrically, controlled. Youths and maidens change colour emotionally, they

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[1] Abstract from the inaugural address of Prof. W. E. Thrift, president of the Dublin local section of the Institution of Electrical Engineers. ("Journal of the Institution of Electrical Engineers," issued April, 1904, vol. 33, part 2).

[2] A milligramme of uranium emits 2*a* particles or electrons per second. The electrons of radium are said to be sped at 100,000 miles a second.

blush. Even adults can blush or turn pale with fear. Flowers, too, pale—they fade. All these instances are enumerated but to show that the object seen, whether it be what one terms alive or inert, is influenced by forces within and without it, which causes movement, which causes a difference in colour. In a similar way, it can be shown that all so-called objects are influenced as to shape and size.

Returning to my exposition of Fig. 5: of course the straight lines *g*, *h*, *k*, etc., as I have drawn them, as also all other lines, may not, are not likely to be, actually straight lines, but wave series, the lines on which they fall being the asymptotes of hyperbola, parabola, arcs or parts of arcs, ellipses, or rings, or centripetal (the view of Maxwell) or centrifugal systems and so on, but on so gigantic a scale, that many seem to us to be straight lines. It were contradictory to our conception of infinity to conceive of space itself being non-homoloidal (both elliptic and hyperbolic).

According to Bilharz,[1]

"Räumlich vorgestellt, das Universum sich darstelle als unendlich grosse Kugel mit unendlich vielen Mittelpunkten; worin also jeder Punkt selbst Mittelpunkt einer unendlich grossen Sphäre ist, und worin jeder Punkt dem all, als vereinigtem Objectpunkt, gegenübersteht, mit welchem zusammen er den Begriff des Seins ausmacht;"

"Conceived from the point of view of space, the universe is represented by an infinitely large ball with an endless number of centres; wherein therefore each point becomes itself the centre of an infinitely large sphere, and wherein each point stands immediately over against the 'all' as united (joint) object-point, together with which it forms the notion of 'being';"

But it must not be thought that because the human mind (represented in this especial instance very ably by Bilharz) is with very great difficulty brought in this connection to grasp much further than a sphere[2] or some slight differentiation thereof, that all ultimate motion is bound to be circular, or even of a nature of which curvature is prime factor, because of limitation within the imagined sphere. Although not at first sight, on closer inspection, this conception of the universe as an infinite sphere is a bastard, the infinite sphere being in this instance a cross-breed of mathematical truth and falsehood. Just as true were an infinite cube; for being infinite, the distances from its centre would also here increase to infinity. The

[1] "Der heliocentrische Standpunkt der Weltbetrachtung," p. 76, by Alfons Bilharz; Stuttgart, 1879.

[2] The sphere being, according to the majority, the most perfect geometrical figure.

same holds good of any shape of cubical content if carried to infinity or else infinity were not: the area or space described is unlimitable. Actually, we do not know if forces are moving through space in curves or not (although induction and intermediary forces make this probable), nor does it matter much at this moment. It does not even matter, for the purposes of our present research, if our own earth will one day, owing to other forces, fly off from the sun and hurtle through space in a straight line or in a zig-zag or a spiral or in some other way, or if it will fall into a larger star, again to be ejected and begin again,[1] and we to live again as Nietzche, philosopher and expounder of the theory of 'Der ewige Wiederkunft des Gleichen' (the eternal recurrence of the same[2]), in his "la gaya Scienza" (joyous science) mistakenly expresses himself:

"Dieses Leben wie Du es jetzt lebst und gelebt hast, wirst Du noch einmal und noch unzählige Male leben müssen; und es wird nichts Neues darin sein, sondern jeder Schmerz und jede Lust und jeder Gedanke und Seufzer und alles unsäglich Kleine und Grosse Deines Lebens muss Dir wiederkommen und alles in derselben Reihe und Folge — und ebenso diese Spinne und dieses Mondlicht zwischen den Bäumen und ebenso dieser Augenblick und ich selber. Die Ewige Sanduhr des Daseins wird immer wieder umgedreht—und Du mit ihr, Stäubchen[3] vom Staube."

"This life as thou now livest and hast lived, thou willst have to live again once and countless times; and there will be nothing new therein, but every pain and every joy and each thought and sigh, all unutterably small or great things in thy life shall again come unto thee, and all in like order and sequence—and even so this spider and this moonlight 'twixt the trees and even also this moment and I myself. The eternal sand-clock of existence (being) will be ever turned around afresh—and thou with it, dustlet of the dust."

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[1] This idea of repetition is not probable, as I have elsewhere shown. To that already said may be added that if a continuous repetition of actions occurred, there would virtually be no such thing as evolution. But an infinite number of forces has really been shown to exist. An infinite number of forces forms, however, infinite combinations, and permutations, or else there were forceless space between the force circles which were self-contradictory, *i.e.*, there is an eternal evolving of one form from another. This therefore contradicts the above supposition. That which exists is necessary: evolution exists, evolution is necessary. If repetition were; the, in a short life's span, often futile efforts at change, be it of the kingdoms, animal, vegetable, or mineral, were unnecessary. But all that exists, each and every force, is necessary. In fact this is the best way of showing *the improbability that matter moves in a closed line.*

[2] Nietzsche says of himself in the "Götzendämerung" (the "Dawn of the Idols"),

"Ich, der letzte Jünger des Philosophen Dionysos—ich, der Lehrer der ewigen Wiederkunft."

"I, the last disciple of Dionysos the philosopher,—I, the teacher of eternal recurrence."

[3] Dustlet is a self-coined word modelled after such diminutives as brooklet, rivulet, and used to signify a small particle of dust. The author thinks herewith best to translate the German word 'Stäubchen,' and not by mote or other kindred expressions.

The reader should be warned here of over-developing his or her mythopoeic faculties.

A conception of the universe, not lacking in beauty nor plausibility, were that the universe be thought of as an infinity of boundless planes, capable of infinite shifting, lying in innumerable directions, such planes being made up of countless lines of force. Each force having its own influence and being in juxtaposition to others, motion is going on infinitely in all planes, the parts of which are elastic to infinity, *i.e.* being capable of being drawn out of place by one force, but never being quite out of control of another. This conception of infinite elasticity is not contrary to evolution, as only in infinity could the original position be attained, *i.e.* never. But, to be funny, these forces are no matter. And therefore it is vain that Bilharz essays the finding of the heliocentrical point of view, which is one midway between our aspect of 'all' outside us and the aspect of ourselves by that 'all'—a point where subject and object are merged. In his own words:—[1]

"Dort, wo das reine Sein wohnt, verschmelzen alle gegensätze, versöhnt sich auch der letzte Gegensatz der zwischen Subject und Object; dort kennt man das Wort Bewegung nicht noch Ruhe; dort verstummt die irdische Sprache als bedeutungslos; dorthin dringt weder das Jubelgeschrei, noch das Aechzen der Welt; dort wird weder die Unermesslichkeit des Raumes, noch die unendlichkeit der Zeit verstanden."

"There, where pure 'Being' dwells, all contradictions melt away; the last contradiction, that between subject and object, is reconciled; there, the word motion is not known, nor rest; there, as meaningless, the earthly tongue is mute; thither penetrates neither a cry of jubilation nor the groans of the world; there is there neither understood the immeasurableness of space nor the endlessness of time."

It is vain, it is useless work even if true, but how can it be true, if the truth be as I have already shown, that we exist and all without us exists also. 'The point of Hypomochlion,' as Bilharz (p. 79) all too exultantly calls it, could never be attained, for aspects are infinitely changing, and by the time a second point of view is found, the centre will have veered. He forgot, frail man,—as which of us does not—that he was treading on Time's ever-shifting sands. Even now, I am being carried against my will into side issues, and shall have to retrace my steps.

I had been discussing the controlling system *Z*. This system *Z*

[1] "Der heliocentrische Standpunkt der Weltbetrachtung," pp. 79-80.

(Haeckel's prodynamis) may or may not be electro-magnetic (the view of Maxwell). This book is no treatise on physics and therefore physical questions will only so far be considered as such considerations run tangential to the sphere of my researches. And the sphere is so large, that only an outline of the characteristics of universal forces can be drawn in this little work. A more exactly detailed and more elaborately worked out scheme of force action is left for another occasion. For the present these force complexities will be just sufficiently marked to show in what relation we stand to the entire.

I have thus far shown that between matter (so-called) and non-matter there is no difference save that the former is more often made known to the senses than the latter; both are force, force in eternal infinite change. As Onimus the Elder says:—

"Ueberall Verwandlung—nirgendwo Vernichtung. In der organischen, wie in der physischen Welt, in den lebendigen, wie in den todten Körpern ist ununterbrochene Bewegung."

"Transmutation everywhere—nowhere annihilation. There is uninterrupted motion in the organic as in the physical world, in the live bodies as in the dead ones."

CHAPTER IV

PURPOSE

"Yet I doubt not through the ages one increasing purpose runs,
And the thoughts of men are widened with the process of the suns."
Alfred, Lord Tennyson,
"Locksley Hall," St. 66.

WE have seen in the last chapter that "the law of the conservation of substance (or the 'constancy of matter,' Lavoisier, 1789), the sum of all substance, which fills an infinite universe, is unchangeable," is inaccurate. Matter, as such, does not fill all space, but force does. Substance can be broken up into component forces having few or may be none of the qualities of matter, the amount of substance is ever changing, and therefore the elaborate building of atomic or electronic bricks of Prof. Haeckel vanishes into space.

It is not true, that which he says:—[1]

"Heute sind alle Naturforscher, welche sich Jahre lang mit dem denkenden Studium der Natur-Erscheinungen beschäftigt haben, so fest von der absoluten Konstanz der Materie überzeugt, dass sie sich das Gegentheil gar nicht mehr vorstellen können."

"To-day all students of nature, who have given themselves over to the intelligent study of natural phenomena, are so firmly convinced of the absolute constancy of matter that they actually can no longer conceive the reverse."

Ask Prof. Karl Pearson, of University College, and others! The ether has. as I have shown (p. 75 f.), a very doubtful existence—at least, as far as this word is meant to represent a universal perfect fluid. The especial ether of Prof. Haeckel is impossible, for on p. 92 of the "Welträthsel" he endorses to a great extent I. G. Vogt's "Das Wesen der Elektricität und des Magnetismus, auf Grund eines einheitlichen Substanz-Begriffes" (Leipzig, 1891), wherein ether is put as something having an existence apart from mass; *i.e.* matter is dual, its components being ether and mass. This pycnotic (compression or condensing) conception is, however, in itself contradictory, for among other items it is thus defined (*vide* Haeckel, p. 89):—

[1] "Die Welträthsel" (Volksausgabe), p. 86, by Prof. Ernst Haeckel; Strauss, Bonn, 1903.

"Die individuelle Verdichtung oder Densation einer einheitlichen Substanz, welche den ganzen unendlichen Weltraum kontinuirlich d.h. *lückenlos*[1] und ununterbrocken erfüllt."

"The individual compression or condensation of a homogeneous substance, which continuously, *i.e.* devoid of gaps and uninterruptedly, fills the entire infinite universe."

On p. 92, however, he expresses himself only conditionally:

"Der Aether erfüllt als eine kontinuirliche Materie den ganzen Weltraum, *soweit dieser nicht von der Masse* (*oder der ponderablen Materie*) *eingenommen ist*,[1] er füllt auch alle Zwischenräume zwischen den Atomen der letzteren vollständig aus."

"The ether, as continuous matter, fills out the whole universe *in as far as it is not taken up with mass* (*or ponderable matter*); it fills up also entirely all the intercalary spaces between the atoms."

How can the whole system of the universe be continuous when there is (α) a point of juncture everywhere between mass and the ether, and (β) points of juncture between ether and mass twice (once on each side) between each two atoms of mass?

But at all events, certain combinations of forces which we call substance or objects do exist. The objects we see, *i.e.* which are evident to the sight, are mostly evident to our other senses also. Thus some things are hard (*e.g.* steel), others soft (*e.g.* wool); these brittle (*e.g.* glass), those elastic (*e.g.* rubber), others again malleable (*e.g.* lead, clay). There are stuffs in all stages of existence, the atoms of some being more tensely drawn to each other than those of the rest (compare air, water, quicksilver, carbon, iron, lead, platinum). One says here, that the force of cohesion is more or less exerted.

Further:—according to the position of exactly similar[2] molecules (atoms, or force groups) to each other, so are often various bodies formed—bodies with entirely different characteristics—and these are called allotropic forms, two instances of which are

(1) carbon as
- (α) graphite—shiny black,
- (β) lamp black—dull black,
- (γ) diamond—transparent white or yellow, and

(2) phosphorus
- (α) yellow,
- (β) amorphous (non-crystallised)—red,
- (γ) a brilliant black.

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[1] The italics are mine.

[2] As far as frail humanity can judge. If we resort to infinitesimals, we shall find ordinarily inappreciable structural discrepancies between any two or more particles of so-termed matter. If carried to the extreme, even the ultimate conditions under which these exist are different. An exact counterpart is an illusion.

This building up of bodies, if I may so term it, is yet more strikingly evinced in the isomerism of organic chemistry. A good random-shot example is to be found among the hydrocarbons of the marsh-gas series, known as hexanes. It will be found by addition of the indices in each of the following chemical symbols, that each body contains six atoms of carbon (C) and fourteen atoms of hydrogen (H),

(1) Normal hexane, $CH_3 \cdot CH_2 \cdot CH_2 \cdot CH_2 \cdot CH_2 \cdot CH_3$

(2) Iso-hexane $CH_3 \cdot CH_2 \cdot CH_2 \cdot CH \begin{cases} CH_3 \\ CH_3 \end{cases}$

(3) Methyl-di-ethyl-methane $CH_3 \cdot CH_2 \begin{cases} CH_2 \cdot CH_3 \\ CH_2 \cdot CH_3 \end{cases}$

(4) Tetra-methyl-ethane $\begin{matrix} H_3C \\ H_3C \end{matrix} \Big\rangle HC-CH \begin{cases} CH_3 \\ CH_3 \end{cases}$

(5) Tri-methyl-ethyl-methane $H_3C-\overset{\overset{CH_3}{|}}{\underset{\underset{CH_3}{|}}{C}}-CH_2 \cdot CH_3$

or $C_2H_5-\overset{\overset{CH_3}{|}}{\underset{\underset{CH_3}{|}}{C}}-CH_3$

C_6H_{14}

In the paraffin or methane series of organic compounds there are groups underlying even greater isomeric variations such as octane (C_8H_{18}) with a possibility of 18 isomers, nonane (C_9H_{20}) with probably 35, and decane ($C_{10}H_{22}$) with most likely 75 forms or structures each with specific characteristics of its own; of the formula $C_{13}H_{28}$ no less than 802 isomerides are known to be probable (though not all found), and so on one could go for examples still more wonderful, through the whole complexity of natural objects around and about us.

Accordingly as the structure varies, so is most probably an object more or less radio-active, and so too would very likely vary the kind of rays emitted:[1] the rays of light received by different bodies are thrown back with more or less force, ejected with in- or de-creased acceleration or vibration. This would yet further account for colour

[1] It is well known to electricians that the particles of steam from a steam jet are generally so-called positively (+) charged. It does not matter at this moment what is actually the state of an atom which makes it positive (+) or negative (−). At a meeting of the London Physical Society (I believe in 1890-1) Prof. Bidwell negatively electrified a steam jet. The steam, prior to the electrification, was invisible (till sufficiently influenced by the air) on account of the repulsion of its particles; but as soon as the atoms received a negative charge, they came closer together (unlike electrics attract each other) and a brownish colour was the effective result.

as in the carbon and phosphorus examples. The reception of rays by the eye is modified by the chemical condition of the aqueous and vitreous humour and of the solid crystalline lens and by the refractive power of these as by other physical properties and by the angle at which the rays meet the respective lenses. It is of course influenced by the condition of the remainder of the eye [the lachrymal apparatus, membranes (sclerotic, chloroid, conjunctive, etc.), cornea, retina, and so on], as also by the general condition (state of health) of the entire human system. It is therefore influenced by drugs, which can cause the entire surroundings to appear yellow or of beautiful hues and the like. On all these states, in less or greater degree, depends our conception of colour.

Be this as it may, it remains a fact that our eyes (their nervous system) are influenced by various objects in various ways.

The eyes may, however, often be similarly acted on by different objects, as they are in the case of the above enumerated hexanes, which are all colourless liquids. Their entire nature (character) is such that no distinction can in this wise be made.

The hexanes all show the faint characteristic smell of the paraffins, *i.e.* act very much like each other on the mucous membrane and thence on the olfactory nerves of the nose. They can collectively therefore be detected from other bodies, but individually they are not distinctly accognisable nor recognisable.

But there is another sense of discrimination—touch—a sense of which Prof. Bain [1] says that,—

> "As an intellectual or knowledge-giving sense, touch ranks decidedly above taste and smell."

I certainly agree with Bain that the sense of touch is different to different people, for it is dependent on (α) the structure of the skin and muscular and other tissues, and on (β) the degree of nervous susceptibility of the individual. When first some persons are very slightly touched indeed [slight both in degree and amount (area of skin affected)], so sensitive are they that there is immediately a sense of tickling. This, I believe, very probably means that the cuticle [2] or protective covering of the true skin (*cutis vera* or *corium*) is very thin, so thin in fact, that mere contact serves mechanically (perhaps also electrically) to separate the individual nerve filaments and fibres embedded in the papillæ (small conical projections of the true skin,

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[1] *Vide* "Mental and Moral Science," vol. i., p. 43, by Prof. (of Logic) Alexander Bain; pub. Longmans, Green & Co., London, 1872.

[2] Called also epidermis or scarf-skin.

varying from $\frac{1}{200}$ to $\frac{1}{100}$ inch in height); this mere act of separation of fibre and filaments giving the sensation of tickling. The less the papillae project and the thicker the cuticle, the less the possibilty to be tickled. But quite recently, Dr. Henry Head[1] has shown that this cannot be the only reason. He has demonstrated that special nerves are affected by slight touch, others by pain, and a third class by temperature and a sense of position: so that our sense of feeling is now in the same relation to the other senses as the older elements earth, air, fire, and water are to our modern conceptions of the elements oxygen, mercury, carbon, sodium, iron, lead, radium, and the like. There is no longer one sense of feeling, but three, a sense of touch, a sense of pain, and a sense of position. It is the first class of nerves therefore which would undergo a separation of their fibres. The nerve filaments and fibres which provide us with our sense of touch are therefore probably nearest to the skin surface.

As soon as contact increased and the pressure were raised, the nerve filaments and fibres of the papillæ would be not only separated from each other, but bent and compressed, thus altering their physical and organic structure. The degree and speed of disorganisation is measured, as far as our bodies are concerned, by the degree of 'pain' felt. That is very likely why, given with the same speed and strength, the blow of a cane hurts more than does that of a stick. The poor little school-boy does not of course understand all this when he gets a 'whacking,' but the fact is, the cane, after landing on a certain spot that shall be nameless, and making it 'sore' (tearing and rending the nerve structures), again quickly rises and sinks (vibrates) each time with fresh destruction to tissue, etc, nor do the bent portions of papillæ and so on remain in their places, but seek with each rise of the cane to return to their former position, only again to be thrown back and 'smart.' Even a single contact of cane surface is not actually a single but a rapid sequence of little blows, inasmuch as the cane being fibrous, its surface varies (if only slightly) with each bend of the cane, causing its fibres to strike consecutively. When the stick strikes there is less vibration, and also less rending, as the stick, pressing down, keeps all parts in their new position. Rapid separation of the particles of our body gives us a sensation which we call heat, therefore the more motion and the more rapid it is, the more heat. A cane blow gives more heat than the blow of the stick and smarts more. Of course Dr. Head's

[1] "The Marshall Hall address" of the Royal Medical and Chirurgical Society, May 23rd, 1905. *Vide* also "The Lancet," May 27th, 1905.

'touch' nerves are as much ruptured as his 'pain' nerves, but these latter are so much more sensitive to pain and the pain is so great that any slight touch by parts of a cane farthest from the skin surface are taken mentally no notice of.

That the nerves of touch and pain are not the same, is seen in that one can tickle a wound and thereby withdraw the sufferer's attention from the pain. As the sensation of heat is, as I have shown, caused by the rapid movement of particles of our body (*vide* p. 58, respecting the sensation produced by radium and carbonic dioxide), of course the same nerve that transmits a sense of position generally, will transmit a sensation of the rapid movements going on on a surface of skin or flesh, *i.e.* transmit temperature.

When a body presses slowly, *i.e.* heavily on us, gradually expanding and trending the tissues, we say it exerts weight on us. When one has experienced the pressure of equal volumes of different materials on oneself, and finds in each case the result another, one material is declared lighter or heavier than another according to its respective capacity for pressing. The physicist and chemist have, for reasons which do not affect the present issue, chosen water as a standard with which to compare all other substances. The proportion which the weight of a cubic centimetre at 30° barometric pressure of any object bears to the weight (one gramme) of an equal volume of water under the same pressure and at 4°C. is the specific gravity (S.G.) of the substance. When therefore we are told the S.G. of any matter, we at once know the relative degree with which it exerts weight, *i.e.* with which it can press on our bodies, thus influencing the condition of its structure. As, by experiment, each of the hexanes has been found to have a different S.G., they may each be discerned, the one from the other, by the relative weight which they exert on our nerves (thus changing their chemical as well as physical nature), fibres, and tissues, *i.e.* by the proportion in change of condition and state which each can produce.

The S.G. of these five substances in order of degree are:

1) 0.6603 (Brühl) or 0.663 (Roscoe and Schorrlemer) or 0.663̇ (Stuart Blofeld, D.S.G.).

3) 0.6765 (Dr. Watts' "Dictionary of Chemistry").

4) 0.6769 (Roscoe and Schorrlemer) or 0.6829 (Dr. Watts).

5) 0.6943.

2) 0.701 (Stuart Blofeld) or 0.7011 (Roscoe and Schorrlemer).

So that, as to weight, (1) affects us least, and (2) affects us most.

Now when, instead of a body pressing on us, we press on a body,

we speak, in the case of solids, of the hardness or softness[1] of that body according to the degree, (α) to which that body affects our person, (β) to which it resists our efforts to change its form. Bain gives only (β) as a means of gauging of the hardness of a substance, but this I cannot endorse; for, theoretically, hardly any two persons will coincide in this point. Accordingly as the tissues of one's body are able more or less to withstand separation and crushing, due to the resistance of the object, and less or more 'pain' is there, and this is mentally taken into account in measuring the hardness or softness.

Now in solids, the constituent particles of a body never move far from each other or "from a certain position of equilibrium."[2] The property of keeping together all particles (due to cohesion etc.), against all attack or stress is 'rigidity,' a quality "which sharply differentiates solids from liquids."[3] The degree or 'modulus of rigidity' of a square bar of any substance is measured by

> "the amount of tangential stress in tonnes (1,000,000 grammes) per square centimetre divided by the deformation which it produces. The deformation is measured by the change (in radians)[4] produced in any one of the four angles of the square bar."[5]

The ideal solid, *i.e.* one of perfect rigidity does not, cannot exist, or else motion would cease where rigidity existed. There is no such thing as a substance capable of absolute resistance against increasing stress. Between a solid and liquid there are many intervening spaces and conditions, the chief being brittleness, crumbling, malleability, viscidity and elasticity.[6] When, supports being removed, the

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[1] 'Hardness' and 'softness' are only relative terms accordingly as we intend to express either how great a resistance (hardness) or how little a resistance (softness) was offered in any instance.

[2] *Vide* "Chambers' Encyclopædia," art. 'Fluid.'

[3] *Vide ibid.*, art. 'Rigidity.'

[4] 1 radian $=\frac{180^\circ}{\pi=3.14285}=57.29578^\circ$

[5] "Numerical Tables and Constants," p. 16, by Sidney Lupson, M.A., F.G.S., F.I.C.; pub. by Macmillan & Co., London, 1884.

[6] There is no known solid (or for that matter substance) which cannot in some degree be made so to vibrate as to produce sound, and this fact is a proof of the existence of elasticity. There is no scope in the present work for entering on enunciations of all the above properties of matter, which would of themselves fill a volume; but it may be allowed me, as throwing a side-light on the questions at issue, to note that we have a perfectly inadequate nomenclature for our needs. The elasticity of a piece of india-rubber (the kind intermediary between solid and liquid), where, upon the stress gradually increasing, the particles separate slowly one after the other (but far enough apart to be out of attracting distance of each other—like magnetised filings) changing thereby the form of the entire mass, only to return to their original places on the stress being removed, is not the elasticity of fluids, which is a result of compression; whilst the former is the consequence of being expanded; nor is it the elasticity of the steel or brass spring, which being pressed down again flies up on being released. Each of these three obeys quite different laws and should possess a distinguishing appellation. The 'intermediate elasticity' (shall we call it 'intelasticity'?) of bodies under any given stress varies inversely as the degree and amount of cohesion in those bodies.

molecules have so little or no cohesion that the rapidity and quantity of the molecular motion in a downward direction (due to gravity) becomes visible, one says that that body flows. A body capable of flowing is either a liquid, or a semi-liquid, *i.e.* a body in a state of viscidity.

> "In a liquid, the particles can move about with greater or less freedom from one point of the body to another,"[1]

as long as it is in a containing vessel. In fact, were it not for a containing place, however small, were it not for the interspatia[2] of the solid medium on which it finds itself, *i.e.* were the surface thereof theoretically absolutely frictionless (a condition not existing—at least as far as our cognition thereof is concerned), the liquid would cease to be such. The frictionless surface not coming within our experience, and liquids by their nature collecting only in the lower parts of a surface or in containing vessels (if placed there), the particles of liquids only separate from each other after pressure has been offered to their surface. According to the S.G. of a substance, so do the particles pressed aside, themselves press by their weight to attain their former position. Take *e.g.* a tumbler not quite full of water. If the water surface be forced down at any particular place, the particles will escape all round and force others on the periphery to rise. As soon as the pressure is removed, these particles retake their original level. When one presses, there is also a frictional resistance, and a resistance to the intermolecular motion to be overcome. There is, however, in a perfect liquid, theoretically no cohesion. We cannot here therefore speak of 'hardness.' But as I know no word for the combined effect of the resistance due to (α) weight of particles to be displaced + (β) intermolecular friction, I shall call it 'pontrition' (Lat. *pondus* weight, and *tritus* friction). When now, the weight of the particles has been overcome, *i.e.* when they have been forced out of position to a higher level, they exert pressure to come down again. The force exerted by the particles of a liquid to regain a former state I term 'pression' (Lat. *pressio*, pressure). Pression varies directly as the S.G. of a liquid. It has nothing to do with elasticity (*vide* section 2 of art. 'Elasticity,' in "Chambers'

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[1] *Vide* art. 'Fluid,' in "Chambers' Encyclopædia."

[2] 'Interspatia' (plural of interspatium) a self-coined word for the hollows, or spaces between the particles of the surface of a body, the body not being continuous. It can be used for the space between particles of so-called diffused matter in space, and in geometry, by deduction, for the space between points or the extremities of lines (Fig. 5*a*).

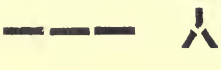

Fig. 5*a*.

Encyclopædia"), but stands in direct relationship to viscosity (as defined in art. 'Viscosity' in "Chambers' Encyclopædia," ed. 1889). The resistance of our tissues against pression is 'contra-pression.' The combined effect of pontrition + pression I name 'pontrurtion' (Lat. *pondus*, *tritus*, and *urgere*, to press), and the force to overcome this, 'contrapontrurtion.' When however, as in viscid bodies etc., there is a cohesion to be overcome, but the amount or degree thereof is insufficient to cause rigidity, there is yet no 'hardness,' for this word is reserved to describe a given property of rigid bodies only. Pontrurtion + cohesion (up to the point of rigidity) shall therefore be designated 'cohurtion' (Lat. *cohærere*, to cohere, and *urgere*).

Although it was not absolutely necessary for present purposes to go into all these details, I have done so here, as it opens out a vast tract for further research, and even if not in this work, I shall sooner or later come back to them. The only point for momentary needs is to notice that the cohurtion of our examples—the hexanes—is in all five cases so much alike, that our sense of touch, being insufficiently delicate, fails to discern one from the other, although a fish, being equipped with nerves possessing a higher sensitiveness for touch, might do so.

On heat[1] being applied to the five, one after the other completely eludes our grasp; they have vaporised and have become gases.[2] Even the slight sensation produced by cohurtion is absent, and we accognise want of touch. But before this point is attained, these liquids increase in degrees of temperature,[3] causing

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[1] Heat seems to be due to the electrification of bodies, *i.e.* the imparting to their molecules a certain amount and degree of intermolecular motion (*vide* the electric current in a copper wire on p. 79), which on our bodies gives a sensation we call heat. If so, heat were no form of energy but another name for a given amount and degree of electrification. Intense heat (*i.e.* very great motion of the heat giver) rends the tissues and gives the pain of burning, as already mentioned in footnote [1] to p. 58 and p. 90). A German journal mentions a mixture of phenol, saponine, camphor, and essence of turpentine, which they call cryostase, having the remarkable character of becoming a solid when heated and a liquid when cooled. That means to say that heating (electrifying) the mass, charges some molecules positively (+) and some negatively (−). This is not, however, the only exception, as water is known to have its greatest density at 4°C. We may be nearing the accognisance of new phenomena and laws comparable to that of magnetism and diamagnetism. The heat of a flame is the result of the rapid vibration of its gaseous particles, whilst its light is the effect of the yet more rapid vibration of similar particles.

[2] The particles of the hexanes, by heat (special form of motion due to electrification), no longer lie friendly side by side, but hurtle and repel each other in space—in fact, will have nothing to do with each other—and, if left to themselves, would become diffused independent microcosms. The cause of this tendency to diffusion will be treated in another work.

[3] Heat causes much more motion in and affects much more rapidly some bodies (substances) than others, so that the result becomes even in certain instances visible, as is the case with quicksilver. The measure of visible changes as compared with a given standard change are called degrees.

ever more pain, for through the increased movements of their molecules, they more and more rend our tissues. The sensation of heat, like that of hardness, is accognised variously by different individuals according to the delicacy of their nervous system and the thickness of the cuticle. It has not, like a degree, any absolute character, as some warm quicker than others. Some—the electrons of their molecules being already more prepared for electrification—are easier brought to the point or degree where the molecules repel each other [*i.e.* to the Boiling Point (B.P.)] than others; that is to say, are more volatile. Those that are most volatile are those which will first scald us, *i.e.* give us the most pain. We can therefore compare the hexanes by comparing (α) the relative rate at which each can most hurt us, (β), the relative rate at which we lose accognisance of their presence. The relative rate is the same for (α) and (β), and as follows:—

	B.P.		B.P.		B.P.
1.	71° (69°?)	3.	60°	5.	43°—48°
2.	62°	4.	58°		

or in other words (5) would be the first to burn us and the first to elude our touch, whilst (1) would be the last to hurt us and remain the longest within our cognisance.

We can detect the hexanes one from another not only by how they act on us, but by the degrees with which they influence other things chemically (chemical action and reaction) and physically.

Exempli Gratiâ: Faraday found that transparent bodies have the power, when in the magnetic field (a medium traversed by lines of magnetic force, as, for instance, the space between the two poles of a magnet), of rotating, or rather deflecting, the plane of polarized light[1] passed through them.[2] The angle of this torsion is dependent on the thickness of the stratum through which the light is passed, the strength of the magnetic field, and the nature of the substance. The torsion of a certain given thickness of any substance in a given strength of the magnetic field, divided by the density of the substance and the angle of deflection of water under similar

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[1] For a good definition of polarised light and plane of polarisation, *vide* "Lexikon der Gesamten Technik," art. 'Polarisation des Lichtes,' by Otto Lueger, vol. vi.; pub. by 'Deutsche Verlags Anstalt,' Stuttgart und Leipzig, 1901.

[2] It would be interesting, *vice versâ*, to measure the resistance offered by polarised light to deflection. This is probably dependent on the strength of the magnetic field, the degree, quantity, and colour of the light, the nature of the source of emission, and the nature, density, total mass, and thickness of the media (both of the transparent substance, and of the air or gas in which that substance is lying).

conditions, is the 'Specific Rotation,' which, multiplied by the molecular weight of the substance, gives the 'Molecular Magnetic rotary power' (M.M.).[1] The M.M. of the first three hexanes which have been experimentally ascertained are:—

M.M.	M.M.	M.M.
1. 6.670	2. 6.769	3. 6.784

i.e. polarised light is more deflected by (2) than (1), and by (3) than (2).

Lastly, although isomerides—*i.e.* having the same individuals like a mixed West End Club—each hexane comes into existence through the loves and sympathies (chemical affinity) and the liaisons (chemical reactions) of different chemical substances.

We have, as usual, been wandering; but I believe it is no error to cast side glances at the road right and left of us, and to take notes for future occasions, by reading the various directions on the sign-posts and mile-stones on our way. If you remember aright, I mentioned the hexanes only incidentally as a useful example on which to demonstrate that we are more or less, either directly or indirectly, acted on (influenced) by all other objects or forces around and about us.

Even in the dark, these actions on us take place; in more or less degree we are directly or indirectly affected by all the force forms of the universe. In like wise does our influence extend to infinity.

The warmth of our bodies makes other things warm. I have often killed glacier-fleas, living in the 'ice-cold' pools of Swiss glaciers, with the warmth of my hand. The warmth of my hand melts snow and ice. Our voice, on lofty heights in a clear air, is heard reverberating amongst the rocks for miles. In fact, an echo and a mirror capitally illustrate this interchange of action between man and the world outside him. Mons. A. Charpentier, the French physicist, has (says "Science Siftings" for 1904) shown that the phosphorescent luminosity of barium platino-cyanide can be increased by 'N' or Blondlot rays emitted from muscles and nerves of the human body—most probably, I may add, this *viâ* the ganglion or sympathetic system. Dr. Hooker,[2] after experimenting on over three hundred persons, finds that these N-rays even alter in colour according to the character of the person. Although I do not

[1] The above definition of M.M. is from "Lueger's Lexikon," art. 'Molekular-rotation.'

[2] Dr. J. Stenson Hooker, of Nottingham Place, London, W. *Vide* the "Lancet, 1904.

doubt the most perfect love of veracity of Dr. Hooker, yet I believe he has not made quite the right deductions from the data at his disposal, for judging by the list he gives, it were quite possible for one man to have two or more of the characteristics, with each of which a special colour was associated. *E.g.* the *deep thinker* (deep blue), the lover of art and fine surroundings (yellow), and the progressive-minded one (light green) can all be impersonated in one; but this mixture of colour produces dark green, the colour given by Dr. Hooker for the physically or *mentally ill*, which is absurd. The probability is that the colour of the ray represents the state of mind of the person at the moment of the experiment only; the same individual tested twice may probably radiate quite a different colour. Our 'will' can be imparted to fellow-men, to beasts, and thus to things. One can be mesmerised, hypnotised, and ruled by suggestion. One can be put in the epileptic or cataleptic state by the sheer force of will of the operator. Whole crowds can be swayed by the words of the politician, the cheap-jack, the parson, the quack, or by examples of individual or collective bravery or cowardice. If or no, inorganic substances can be directly influenced by the human will, remains, as far as I am here concerned, an open question; although the usually cautious Schopenhauer[1] accepts without reserve, as authentic, two cases in which somnambulists, by concentration of will, are said to have deflected the compass needle. These two solitary instances are in themselves not sufficient evidence on which to build up any theory. But in some way or other all things are influenced by us. They are most certainly influenced indirectly. The object or medium of transmitting influence is the 'agent,' as when a cocoa-nut is knocked down with a ball (the agent) thrown by a precocious inhabitant of 'ampstead 'eath.

If I raise my hand, the force so to do appears at first sight to be spontaneously generated. Is it sufficient to explain it by nerve excitements and muscular contractions, from the fact that an electric current does contract muscle? It is something within me, which, for want of a better name, shall at present be named 'will.' If, as we have just come to think, we conceive of a portion of matter—muscle—as a system of forces, and not as a conglomeration of tangible atoms, and the will as a force or system of forces working on the muscle system, then it is not so difficult after all for the mind to grasp the idea of the action which takes place.

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[1] *Vide* "Ueber den Willen in der Natur," p. 299; pub. Ph. Reclam, Leipzig.

If I have a headache, I can will this pain away. I can, at will, conjure up the image of a dog. I can wish to imagine a dog before me, and behold it is there; not the dog, but the mental image of it. Many of us have doubtless read of Rudyard Kipling's telepathic message from his dead dog. If our ideas can be willed to another, there is no reason why they, or even what is taking place at a distance, should not be involuntarily transmitted. It would be a sort of animal long-distance telegraphy without wires.

It will soon be seen, that the same or to all intents and purposes similar actions can be brought about by dissimilar causes. Schopenhauer[1] gives examples:—

"Auch giebt es noch besondere Belege dazu, dass die Bewegungen auf Reize (die unwillkührlichen) vom Willen ausgehen: dahin gehören die Fälle, wo die selbe Bewegung bald auf Reiz, bald auf Motif erfolgt, wie z.B. die Verengerung der Pupille: sie erfolgt auf Reiz, bei Vermehrung des Lichtes; auf Motif, so oft wir einen sehr nahen und kleinen Gegenstand genau zu betrachten uns anstrengen; weil Verengerung der Pupille das deutliche Sehn in grosser Nähe bewirkt, welches wir noch vermehren können, wenn wir durch ein mit einer Nadel in eine Karte gestochenes Loch sehen; und umgekehrt erweitern wir die Pupille, wenn wir in die Ferne sehn."

"There are also certain proofs that movements produced by excitation (the involuntary) are just as much brought about by the 'will' as those caused by 'motive' (the voluntary). To this category belong cases where the same motion is alternately the result of excitation and motive, *e.g.* the contraction of the pupil: it is caused by excitation in the case of increase of light; and by motive, as often as we exert ourselves to scrutinize a small near object; because narrowing the pupil assists in seeing things, close up, distinctly, which clearness of vision can be enhanced by looking through a hole pierced in a card with a needle; and reversely, we widen the pupil when we peer into the distance."

This example is, however, somewhat misleading, for when we look closely at a near object the pupil involuntarily closes, being overmuch exposed to the radiated light in too great a proximity to the object, combined perhaps with an automatic focussing, as the divergence of rays decreases with nearness to the object radiating. The pupil only closes as the result of motive when we put an object to our eye, not to see it better, but for the express and sole purpose of enlarging the pupil, and on p. 227 Schopenhauer actually does give us an instance taken from E. H. Weber's "*Programm additamenta ad*

[1] "Ueber den Willen in der Natur" (Abth. Physiologie).

E. H. Weberi tractatum de motu iridis Lips," 1823, which describes him (Weber) as able to enlarge or lessen the pupil at will,[1] thus at pleasure making objects visually blurred or distinct. It may be added that I have myself seen this feat accomplished by my friendly and learned neighbour, Dr. J. Douglas Cree, of Lymington Road, N.W. We have really therefore not two, but three ways of narrowing the pupil; so that when Schopenhauer makes the statement:—

"Die gleiche Bewegung des selben Organs wird doch nicht abwechselnd aus zwei grundverschiedenen Quellen entspringen,"

"A similar movement of the same organ will surely not emanate alternately from two radically different sources,"

I ask, "Why not?"

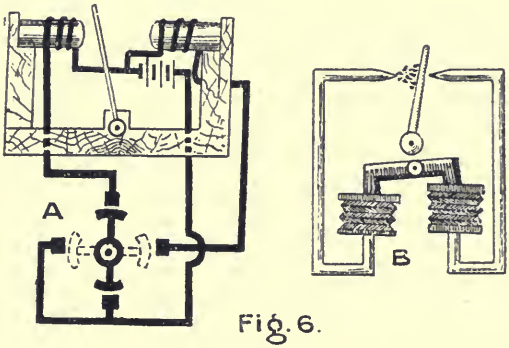

Fig. 6.

Take a thin narrow iron needle, which is so pivotted at one end as to swing freely (Fig. 6*a*). By means of a rapidly rotating alternating arrangement[2] inserted in the circuit (schematically shown), two electro-magnets alternately attract the needle, so that the needle continuously oscillates on its pivot. The same result is attained by an anker alternately striking and forcing downwards two bellows, each in connection with a blow-pipe, one on each side of the needle (Fig. 6*b*). The needle will be blown first to one side and then the other, and an oscillation as the result of repulsion, and not of attraction will take place. A force alternately pushing or/and drawing at each side of the needle will do the same thing.

Just so with the human body. That sneezing can be produced by irritation of the mucous membrane and also by sudden light is well known. The breasts of a female swell[3] during each menstruation

[1] An allied but more common phenomenon is the capability of some persons to move either the scalp of their heads or their ears backwards and forwards, this latter being accomplished by nearly if not all the brutes.

[2] This is derived from the system of and incorporated in my British Patent No. 23,756, A.D. 1901.

[3] This enlargement occurs in some boys when they reach the age of puberty.

although there is no pregnancy. Dr. Arnold Lorand[1] makes mention of the swelling of the thyroid gland in women being often due to "defloration, conception, puberty, menstruation, pregnancy, lactation and the climacterium (menopause)." Thus again, such opposed actions as menstruation and pregnancy are instrumental in bringing about a similar action on the thyroid gland. More convincing is the fact that sweating (the outpouring of the secretion of the tubular sweat glands) may be caused by heat, or by anxiety or fear, *the nerves employed in these two cases not being identical.* Vomiting can be produced by an emetic. Here there is a direct chemical action going on in the stomach, as well as physical. But the direct mechanical action of tickling the back of the throat, stuffing fingers in the mouth, opening the mouth over-wide will produce a practically identical result, the route of the nervous action being probably *viâ* the *thoracic ganglia* to the solar plexus. The mere idea of vomiting affects the brain, and then works on the stomach nerves, producing the same effect. Greatly pleasurable or painful excitement travels probably *viâ* the heart, *cardiac plexus*, and thence after going up to just before the middle *cervical ganglion*, goes down through the *inferior ganglion*, passing through the first six *dorsal ganglia* into the *ganglion impar*, whence it reaches the solar plexus and thus acts on the stomach. In the early stages of pregnancy 'morning sickness' is common. Here the action is most likely *viâ* the *hypogastric plexus* to the solar (*epigastric*) plexus. Rubbing the skin with potassio-tartrate of antimony ointment will excite the vomitory nerves, as will also the action of strong light—the ointment working probably *viâ* the sympathetic nervous system, and light *viâ* the cerebro-spinal nervous system. In fact, I believe that very often similar actions are produced sometimes by the one nervous system, sometimes by the other—nay more, that the ganglia (bodies of grey brain matter arranged each side of the spine), have often initiatory functions, as an indication of which we have the well-known frog experiments.

Likewise, the state of sexual erection can be produced (1) by the natural craving for sexual intercourse independent of person; (2) by partaking of certain food stuffs or drugs, producing the effect, without the desire to attain it; (3) by being in the presence of a female, sympathetic by natural selection; (4) or in the presence of a female, who suggests by word or behaviour; (5) by a person (male or female) who hypnotises and suggests; (6) by direct mechanical

[1] Written from Carlsbad to the "Lancet" for May 27th, 1905 (p. 1,459).

excitation (stimulation or irritation); (7) by sodomy; and (8) by auto-suggestion (mental masturbation). This last effect can be enhanced by excitation of the *aureola* of the *mammary gland* (even of males). We have here (*a*) procreative tendency diffused over the whole system, (*β*) mental influence, (*γ*) influence of foods and drugs, (*δ*) mechanical action, and (*ε*) mechanical + mental action.

I pick from the above, the instance of the action of foods, etc. Foods are substances, and substances are a conglomeration of forces (pp. 78-79) which is under the control of, or rather is part of the entire system of forces outside us and of those of which we form a part.

Looked at in this light, even the exertion of our will is the result of outer influence: the actions which go on in space lead up gradually thereto. Over-much company with the opposite sex, *i.e.* the exposure to overpowering animal magnetic forces combined with certain inculcated ideas of morality, or even the very existence of two sexes are causes of masturbation. So also is involuntary seclusion, *i.e.* a compulsion from without to resist the forces tending to natural selection. But masturbation being an emanation of will exertion, one can say that such will exertion is dependent for its existence on forces outside of us. The idea of a humanly personal will cannot therefore by analogy be applied to united world-forces, the universal system, for this system being infinite, cannot have other forces exterior to it to coerce it; while personal will is but a part of this system, not only capable of action but liable to be acted upon.

There is a profundity of worldly wisdom in Prior's lines :—

> "And if you would improve your thought,
> You must be fed as well as taught."

The stomach, well fed, thinks more vigorously and clearly. Over and underfeeding produce laxity of thought, and therefore often wandering thought, leading one to do that which, in the surroundings in which one finds oneself, is unusual, *i.e.* wrong. Food, as we have seen, can also excite and rouse, thus driving us to do that for which we are afterwards sorry. Sir Henry Boscoe[1] said that

> "He came to the conclusion that it was the potential energy of the food which furnished the actual energy of the body, expressed either in terms of heat or mechanical work. There was, however, another function which came into play in this function. It concerned the action of the mind on the body, and the body on the mind, and although incapable of exact expression, exerted none the less an

[1] Inaugural Address to the British Association, in August, 1888.

important influence on the physics and chemistry of the body, so that a connection undoubtedly existed between intellectual activity or mental work and bodily nutrition." [1]

In other words, the personal strength of will was to a great extent dependent on the quantity and quality of inorganic stuffs taken as food. Mental strength and capacity are dependent on corporeal strength and robustness. The brain is strengthened in the same proportion as is the body. If we turn to statistics, we find the same result in another form. Men are physically and mentally stronger than women,[2] and the brain weight of men of all races is 10 % heavier than that of women; whilst, what is more important, there is a 5 % increase of brain surface (corresponding to an increase in the number of folds or convolutions) on the part of men. Again, the Scotch, German and English races are about the healthiest and strongest. The Scotch brain weighs on an average 50 oz., the German 49.6 oz., and the English 49.5 oz., whereas the corporeally weak Esquimaux has a brain of but 43.9 oz. With both sexes, the brain increases in weight up to the age of forty, remains stationary between forty and fifty, and loses an ounce every ten years after fifty. The brain, and therefore the will, develops with the increase of bodily strength, and does not increase after forty, although the experience gained may be greater after that time; and the brain, and therefore the will, loses weight and force with the loss of physical energy.[3] It may be said to be an axiom, that loss of brain

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[1] Therapeutically interesting is the fact that in 1903, Dr. Joire found that red light aided the digestion, worked beneficially on the bowels and helped the general sustaining of the body more than white light. This is easily understood, as we have seen that too much light even acts emetically. It is a well-known fact that sailors deprived of fresh water, assuage their extreme thirst by soaking their clothes in salt water, the moisture penetrating through skin and flesh to the organs in question. It is thus easily seen that damp or foggy or clear atmospheres have a direct channel to the entire system. Temperature, calm and storm also work on the nerves and ganglions, influencing digestion and thus also character. Dr. Joire further found that blue light slowed the circulation of the blood. This colour has also been shown to act anaesthetically (p. 40) and it can also work soothingly on hypnotised patients or even lunatics. Here, of course, the greater the brain excitement the greater must be the number of the light waves which reach the brain through the medium of the eye; and the next colour to blue—violet—possessing the greatest number of waves in a given light-ray length, is chosen as most soothing to the wild excitement of frenzy. One accognises that many agencies are at work controlling mechanical action. Dr. Foveau has for years been experimenting in the above wise with similar results.

[2] Women have now more bodily movement than formerly, and were it not for artificial life in all its phases, they would be yet more robust. General physical conditions will, however, permanently be a bar to success in general competition against men.

[3] Other statistics of a similar nature, comparing the brain weight of the average European with a list of celebrities on the one hand and with idiots on the other, are given by Bain ("Mind and Body," p. 19-20; pub. London, Kegan Paul, Trench, Trubner & Co., 1892), but the European average is too high. And his statement "When extensive statistics are taken, the conclusion is established that great mental superiority is accompanied with a more than average sized brain," is misleading, for

power coincides with loss of will power. Great thinkers very often concentrate so much will in their work that very little remains to react on the outside world. Such men fall an easy prey to more matter-of-fact individuals. Two pathologically interesting apparent exceptions are to be found in the cases of wild delirium and lunatic frenzy, where seemingly loss of brain power is followed up by increase of will centred on the muscles of the body: but here it is simply will run amok, so to say, and the pent-up will energy of the system is, without directive restraint, let loose till it is rapidly spent. Will force has its measure and its limit. The unintelligent flying about of the limbs and the body may perhaps not inaptly be compared to a phenomenon of lesser degree: the sudden standing on end of hairs after fright. From personal investigation of cases brought under my notice, I have found that the majority of individuals so affected had strong hair, that is to say, when the hair-life was more spent, it would be less acted on by the nervous discharges, just as the madman's antics become less violent when the life energy is all but gone. Death throes have their origin in reflex action and stand quite outside the present issue.

The sadists love, and yet, in all their actions, erotic functions are wanting. I have, on two occasions, exerted my will to get others to go to sleep, and have had them spring up wildly from their seats as if they had been possessed. A handsome face attracts some, an ugly face others; many love that which others hate. These are instances of contrary suggestion, *i.e.* willing one thing and obtaining a reverse result.[1] Therefore persons or things presented to others for a given purpose may have quite a contrary result to that intended. There are probably positive (+) and negative (—) wills. *Therefore when certain actions are seen following as the result of certain other actions, sufficient evidence is never-the-less not at hand*[2] *that by relation and analogy we could say that therefore we see will in everything.* Although, as we have learned (p. 60), everything serves a purpose.

~~Although I have gone to the trouble to prove that, up to the present, science has not given us sufficient cue, I hope to show that~~

the high mental value of a great many Jews has not the corresponding increase in brain weight, whilst dangerously wild lunatics have a brain weight little inferior to the average, for the quantity of brain matter is requisite for muscular expenditure. The low weights given by Bain for idiots are for those of not great bodily activity, whilst his celebrities were certainly not of men weak of will and wanting in vital energy.

[1] In mechanics, a cogwheel, rotating from left to right, carries its neighbour from right to left.

[2] Another good reason against the setting up of scientific dogma based on that actually seen.

Cohesion, chemical affinity, magnetic attraction (organic and inorganic), friendship, and love, or electric and magnetic repulsion, electrolitic action, enmity and hate and so on, are, what one may term, various tendencies of one force to act in a given way on certain others. Like all other things, these tendencies are there for a purpose. Now if each person, thing, or simple force had its own independent will or tendency and each its purpose, then three suppositions present themselves: either that

(1) All forces are agreed so to act that none thwart the other, or that

(2) All forces are agreed one to help the others, or that

(3) Each force acts solely to its own advantage.

Before I take each of these cases separately, there is one general answer to be given to all three.

When the force called light[1] falls on certain objects it can be immediately broken up into, (*a*) a part reflected, (*b*) a part into chemical action, (*c*) a part heat, and (*d*) a part mechanical action. The proportionate distribution of these parts does not now concern us. The part reflected (*a*) can again fall on an object, and be similarly broken up to the original force. (*b*) Can at once be broken up into the components (*a*) heat, (β) mechanical force, (γ) electrical force. Now $(a) + (\beta) = (\gamma)$, (*a*) can produce (β), (β) can produce (*a*) and (γ), whilst (γ) can produce (*a*) and (β), and so on.[2] Thus can it be said that one form of force can pass into another force, and the study of physics will demonstrate this fact,—that every force can be turned into other forms. This being so, we have not actually several individual forces, but one force taking many forms. *Individuality of the forces does not therefore actually exist.* Take two opposite arcs of a circle. If a force be driven right round the circle, the force in the one arc is seemingly in the reverse direction to that lying immediately opposed thereto. It is only by a

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[1] A distinction must be made between the force—light, the phenomenon of light, and the sensation of light.

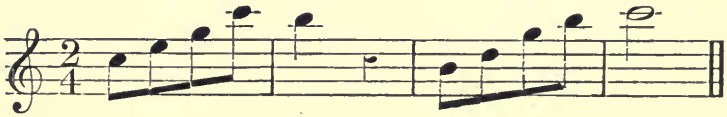
[2] It is noteworthy that Spencer in his essay, "Progress: its Laws and Cause" ("Essays: Scientific, Political, and Speculative," by Herbert Spencer, vol. i., p. 37, 1891; pub. Williams & Norgate, 14, Henrietta Street, London, Library ed.), makes a law out of the above statement to the effect that:—"*Every active force produces more than one change—every cause produces more than one effect*"; and he goes on to give examples very similar to mine. For certain reasons, which need not here be entertained, I refrain at this moment from examining the evidences which led Spencer to thus formulate the fact.

knowledge of the circle that we get a true knowledge of what goes on in the arcs.

As forces do not individually exist, supposition (3) falls away immediately.

Supposition (3) also falls away for another reason. If each force fought only its own cause, we should have no co-operation, no harmonious flow of actions in any given direction. There is, however, co-operation, as when two component forces sink their individuality in one resultant force partaking of the nature of both. Strike a ball simultaneously in two directions not exactly opposite each other, but both acting on the same side of the diameter, and there will immediately be a molar movement in a direction between that of the two initial forces;[1] or, if the forces be one to each side of the diameter the resultant is rotatory, and may or may not be in a given direction also. If two political parties—each formerly independently swaying the destinies of a nation—merge into one, a new party is formed, having tendencies (exerting influences or force) partly taken from each of the original bodies, but new principles may never-the-less be embodied.

We have a harmonious flow of actions when Schopenhauer[2] gives us his celebrated four-bar period of music:—



He tells us how the first bar, ending, as it does, with the tonic or key-note, gives us no finite satisfaction, for the rhythm is in the inferior part of the bar. Immediately afterwards, in the second bar, the rhythm is in the right part of the bar, but the note is this time the seventh. Here, he goes on to say, the two elements of the melody have quarrelled with each other, and only in the fourth bar are they again united. Schopenhauer has probably erred in this

[1] Although theoretically true absolutely, that is to say, if only a point be considered and not the mass, the resultant of two or more forces is actually never exactly the sum of the effects of the components, for, as in the case of the ball, a part of the striking force is turned not into molar but into molecular or electronic movement of the mass of the ball. Just in the same way, "the true electromotive force (E.M.F.) of many voltaic elements is not the same as the value calculated from thermo-chemical data, *i.e.* from the known reactions of the constituents of the element" (Phil. Mag., vol. xxvii., p. 209, 1889), but this does not negative the existence of co-operation. It only demonstrates afresh, that which I have often essayed to show, that the laws of natural philosophy as applied to mass, the laws which we deduce as binding on mass, are not binding in exact mathematics and *vice versâ*.

[2] "Zur Metaphysik der Music," being the third book of vol. ii. of "Die Welt als Wille und Vorstellung," p. 535.

last. There is only one element in the melody; the harmonious progression of notes depicting a yearning in some direction towards fulfilment of some purpose, which is apparently attained or achieved in the last bar. There is a fluctuation in the degree of expectations of obtaining the end, comparable to the waves in a flash of light, and these fluctuations may be caused by other forces in the same medium (interference),[1] or by some other resistance causing oscillations after the manner in which I accounted for the oscillations in a flash of lightning.[2] Often, as is the case with much Hungarian music, the speed of musical tendency (current), if I may so term it, near the end is so greatly accelerated (being attracted by auto-suggestion), that a sort of musical fire-ball forms, which reaches to such a velocity at its centre, that it suddenly bursts, leaving the hearer not satisfied but exhausted and spent.

But I was careful just now to say that the end looked for was *apparently* reached. Is it ever actually arrived at? Does the final key-note always murmur 'rest'? Rightly enough does Newman Howard sing—for his prose essay, "The Warp of the World," is a lovely song, if nought else—

> "Into the minor triad, the semi-discordant or semi-stable $\frac{15}{16}$ enters, producing a sense of unrest and infinality."[3]

And does the major triad, which Howard tells us has been essayed by Bach and others as a more satisfactory close to the minor key, really produce complete satisfaction? Does not rather this abrupt close jar, and thus breed disquietude and foster dissatisfaction? Has not each note, however simple, its anharmonics? But why harp on this last chord? What, at its best, is it worth as a factor of peace? Are there not in a tune x times as many bars of unsatisfied longing as that one end bar with its final key-note? And do not the stirring sounds of these again and again reverberate through the brain, rousing or subduing one, stirring and exciting, or awing and pacifying, making one crestfallen, downcast, and sad; cheered, exhilarated, or salacious; resolved (for good), or irresolute; or dogged, or savage, or even criminal, long after the last key-note was struck? The tune, air, reverie, symphony, rhapsody, phantasia, or whatsoever it may be,

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[1] *Vide* definition of 'interference' in any good book on sound and music.

[2] *Vide* a communication by me to the discussion on Prof. Oliver Lodge's paper, 'Lightning and Lightning Conductors,' in the "Journal of the Institute of Electrical Engineers," vol. xviii., 1889, p. 529.

[3] *Vide* art. 'Warp of the World,' by Newman Howard, in the "Hibbert's Journal" for January, 1905; pub. Williams & Norgate, 14, Henrietta Street, London.

rouses ever afresh years after the notes are dumb, it liveth on and on and dieth not: the melody, the yearning remains, for it cannot be satisfied:—

> "The tides of Music's golden sea
> Setting towards eternity,"

and only on the ever-receding shores of Infinity do these mighty billows break. In infinite movement there cannot be perfect rest. How then could music—that mighty language of the waves—any more than the simplest phraseology of nature, give final quietude? Music is a harmonious flux; its wave crests synchronizing with the wave tops of the ocean of the feelings, and of the passions of mankind, and of brutes.

This harmonious flux proves that there is co-operation, that each force works in with the others, and does not selfishly go its own way.

Suppositions (1) and (2) are easily disposed of; for an infinite number of forces could only agree with each other in infinity, *i.e.* never, *i.e.* the two suppositions are therefore *ad occulos* absurd, as never agreeing, no purpose could be served. If any other proof were at all needed, it is only requisite to add (in continuance of a former paragraph), that, as a force changes its form, these forms are not in themselves in a position to come to terms with each other, being actually but one; one, and only one force exists which can be accognised or experienced in many ways and aspects.

We have very probably in infinity an endless number of "*infinitely continuous groups*" of these force-forms; such groups being of the nature of those mathematical ones of Lie.[1]

But, to repeat, there is only one force and one purpose, although when the immediate object of that purpose is attained, another purpose looms ahead; for an ultimate goal is impossible, as it would be the cessation of that which I have shown never can cease, motion. One single purpose and a perpetual changing are not two such unreconcilable conceptions after all.

It is a great mistake to point to certain natural phenomena for which one does not at the moment see a purpose, and then on these grounds alone to deny the existence of a purpose to everything.

There is apparently no use for the cavity in the cheek of the South American paca (*Cœlogenys paca*), formed by the enlargement of the zygomatic arch. It is evidently not for food.

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[1] "Ueber unendliche kontinuirliche Gruppen," by S. Lie, Christiania, 1883. *Vide* also other works by same author.

When that pasha, the African ostrich, plays the rôle of mother, by sitting on the eggs which his four or five wives have laid, he is unable to cover them with his body and thus hatch them all, so that many, receiving no warmth, go foul.

Darwin,[1] at Bahia Blanca, in 1833, noticed how often uselessly the casarita (*Furnarius cunicularius*), a small species of bird closely allied (except in the matter of nidification) to the oven-bird or casara of La Plata, bored holes right through thin house walls, believing these thick enough to build narrow cylindric passages, six feet long, at the extremities of which to build their nests.

How easily might one be tempted to deduce from all these cases the purposelessness of the paca's pouch, of the superfluity of ostrich eggs and of the aimless acts of the casarita. And yet, as all these things do exist and take place, they are necessary, are to a purpose although that purpose is unknown to us. It were absurd to have, in each individual case, to prove afresh the existence of a purpose in everything.

Spencer[2] tells us that

> "An infusorium swims randomly about, determined in its course not by a perceived object to be pursued or escape, but apparently by varying stimulæ in its medium."

The tiny human seed-threads (spermatozoa or spermatozoids, of which about 250 go to a millimetre), when in their natural element, (the secretion of the Cowper glands, etc., or in solutions of sugar, salt, albumen, phosphate of soda, bloodserum, urea, and so on) writhe and scud about, seemingly perfectly aimlessly, being propelled or moved by a combined action of contractivity and endosmotic[3] action. That they arrive at and fructify the female ovum is apparently mere chance. Yet there certainly existed a number of forces, the aggregate of which formed the infusorium, the spermatozoa, not by chance but for a purpose, and the stimulus of the media in which they severally executed their antics purposely existed and purposely acted on them: to what purpose is begging the point.

"Aber warum in die Ferne schweifen, denn das Gute liegt so nah'" is an old German adage. We have only to turn for an example to an action made by many of us in everyday life, and at which I caught myself at this very moment. I was weighing in my mind

[1] "Journal during the Voyage of H.M.S. Beagle round the World," by Charles Darwin, M.A., F.R.S., chap. v., p. 69; pub. Ward, Lock & Co., 1889.

[2] "Principles of Ethics," by Herbert Spencer, vol. i. p. 1; pub. Williams & Norgate, 1897.

[3] Endosmosis is the name of the action of the intermixing of two fluids through a finely porous partition. Formerly called osmosis.

how best to continue writing, when my attention was suddenly called to the fact that the hand carrying my pencil—I always write my crude ideas in pencil first—was guiding the point at about one-eighth of an inch above the paper, at a very rapid rate in remarkable curves and spirals: its tendency to write was far in advance of my actual writing, for I had not framed the sentence. The movement of my hand was seemingly perfectly useless. But, among others, it probably served two purposes, neither of which were for my especial benefit: it expended the mechanical energy of my body, aiding in its small way to bring about my death, and it called my attention to its existence, thereby enabling me to record and use it for the enlightenment and improvement of others. A pretty example this, for it teaches us that not for ourselves but for others are we here, we are not to live for ourselves but for others; prayers for our own good only are worthless, our deaths will be just as useful as our lives.

It was the late Louise Michel, 'the red maiden of the Revolution,' who made the utterance,—

> "What is human life when great ideas are at stake? The killing of a few means the emancipation of many;"

and directly in connection with the Russo-Japanese war, she once exclaimed:

> "Ah, this war! It is folly. But it is a war that will kill war. People are learning that this is not a time for killing, but for life, for work, for art, for science, for fraternity."[1]

Nay more, all the evils that mankind, as a whole, has to suffer, are as much there for a purpose as are the good things of the earth. Carlyle wrote:

> "There is but one temple in the universe, and that is the body of man. Nothing is holier than that high form. Bending before man is a reverence done to this revelation in the flesh. We touch heaven when we lay our hands on a human body! This sounds like a mere flash of rhetoric, but it is not so. If well meditated, it will turn out to be a scientific fact; the expression in such words as can be had of the actual truth of the thing."

Carlyle considered man to be the coping-stone of creation; he probably thought man the aim of the creation. But this thought was more concisely expressed hundreds of years before.

The following conversation once took place between a stranger and the sage Pythagoras:[2]

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[1] *Vide* the "Daily Mail" for January 10th, 1905.

[2] *Vide* Kerning.

STRANGER: "Thinkest thou that man could not have existed, had not the creation been as great as it is?"

PYTHAGORAS: "At least, not so as he is."

STRANGER: "Then according to that, man bears within him some part of the creation?"

PYTHAGORAS: "So is it."

STRANGER: "Then you hold mankind to be the highest created thing?"

PYTHAGORAS: "He is it."

STRANGER: "And the purpose of nature?"

PYTHAGORAS: "To bring forth mankind."

Now, as I have shown elsewhere (*vide* p. 55, etc.), we actually do experience all the force forms in infinite space. We therefore agree with Pythagoras, that man is in some wise influenced by all nature's parts, but so also is every part in some way or other influenced by all the other parts. You see, he was wrong too, in thinking that the sole purpose of nature was to satisfy a part of it. To form man may have been a goal, which goal reached another looms ahead. The cosmic search for a goal means life to the cosmic forces.

Le Prieur, the modern Pythagoras, even went to the extreme of avowing that ebb and flow of the tides was there for the ingress and egress of vessels, and rightly was he laughed to scorn by Voltaire. Voltaire, in one of his larger poems, ironically and yet with as much truth as Le Prieur, makes the mice praise God for giving the earth such capital mouse holes, and he causes the donkey to boast that all was created for him, man was his slave to wait upon him, to stroke, to wash, to feed him, and to provide him with a helpmate. Yet whilst denying a purpose adapted to the wants of individuals, Voltaire does see a purpose in the universe as an entirety, or what he calls providence: a course of events planned ahead. So do we, but in what degree is to be see anon. "Why," says he,—

> "make a chain of woe or misery out of our existence? To conceive the world a prison and all men convicted criminals is the thought of a hater of mankind; to believe that the world is a place of perpetual pleasure is the dream of a debauchee; to know that the earth, the people, the animals are as according to the order of providence they should be, is the sign of a sage."

K. C. v. Baer and Dr. J. Reinke[1] (although by conceptions not

[1] "Aus der Combination der Intelligence mit der Energie entstehen in den Organismen die Dominanten."

"Out of the combination of Intelligence with Energy results the coming into being of the dominants in the organisms."

"Die Welt als That," by Dr. J. Reinke; pub. Paetel, Berlin). These Dominants stand in the same position as in Babylon the Sun-God, Marduk, stood to Ja-ah-ve (Jehovah). Mathematically they are Lotze's second-hand forces.

shared by me) have both arrived at the conclusion of the existence of a purpose, of a striving in nature towards a goal that has not come there by chance. To judge of the 'World Force' by taking man, or in fact by taking anything however large or complicated for a standard, is simply ridiculous, for all finites in boundless space are the parts of the infinite and therefore unknowable, for says Spencer[1] correctly,—

> " . . . . there is the secondary truth that there can be no correct idea of a part without a correct idea of the correlative whole. . . . And again, the position which the part occupies in relation to other parts,[2] cannot be rightly conceived unless there is some conception of the whole in its distribution as well as in its amount."

When Dr. Reinke,[3] the botanist, says that God could have taught a universal religion and have had it carried out had He wanted to, he is wrong. As every act is to achieve a purpose, a necessary purpose, the battle of the creeds serves a necessary purpose. Force could not therefore want to or have a tendency to do the reverse, which would be against the existing tendency, it would be against His characteristic, contrary to His nature. To discuss here why this combat of the religious orders and of religiously minded votaries should continue were out of place. For the present let the fact suffice.

But it can here be added that it ~~were~~ would have been just as impossible for the 'All-pervading force' to have made the ostrich hatch every egg, or to have caused the casarita to rightly choose her nest. Arguing purpose only as we see it, we might continue in the following strain: " Little birds are useful, for they prevent the all too rapid increase of insects, and they cheer by their presence and their song. But the same birds, if they took the overhand, would annihilate our crops, therefore must we have birds of prey to eat the surplus up. But why? Why did not 'All Force' at once produce birds that did not multiply so quickly? Why did it produce insects that had to be eaten up?" Be sure there was a purpose or else He[4] had not done it. There being a purpose, He could not have done otherwise. The

"Wissenschaft von den rudimentären, abortiven, fehlgeschlagenen, atrophischen, oder Kataplastischen Individuen,"	"science of the rudimentary, abortive, unsuccessful (faulty), atrophic, and cataplastic individuals,"[5]

is not true Dysteleology, as far as the " Universal Force " as a whole

[1] "Principles of Ethics," by Herbert Spencer, vol. i., p. 1.

[2] *I.e.* the part it is playing, the purpose it is serving.

[3] "Die Welt als That," by Dr. J. Reinke.

[4] A personification of speech only.

[5] "Die Weltärthsel," by Prof. Haeckel, p. 106.

is considered, although it may be true in single or single classes of objects. To try and prove the uselessness of certain parts of organs of plants, fish, reptile, beast, or fowl, or even in man,[1] does not prove their utter uselessness to the entire. These landmarks of evolution, these progressive links have their purpose; the entire system of evolution from free forces to inorganic nature and from inorganic to organic, the system of evolution of science, music, mathematics, ethics, and so on has a purpose, or else it were not, I do hope, with this teleological conception, to have put dysteleology in disgrace. I trust this opinion will be that of very many others; but it is here presented with all due deference for the views of those others and not laid down as dogma, as is the opposite contention of Prof. Haeckel,[2] who, clever as he is, has the knack of posing as infallible:—

"*Der Mechanismus allein* (im Sinne Kant's!) *giebt uns eine wirkliche Erklärung der Natur-Erscheinungen* indem er dieselben auf reale Werkursachen zurückführt, *auf blinde und bewusstlos wirkende Bewegungen*, welche durch die materielle Konstitution der betreffenden Naturkörper selbst bedingt sind.

"Seitdem Newton (1682) das Gravitations-Gesetz aufgestellt, und seitdem Kant (1755) 'die Verfassung und den mechanischen Ursprung des ganzen Weltgebäudes nach Newton'schen Grundsätzen, festgestellt—seitdem endlich Laplace (1799) dieses Grundgesetz des Weltmechanismus mathematisch begründet hatte sind die sämmtlichen anorganischen Naturwissenschaften rein mechanisch und damit zugleich rein atheistisch geworden . . . *Seitdem ist aber auch der Zweckbegriff aus diesem ganzen grossen Gebiete verschwunden*. . . . Jetzt, am Schlusse unseres neun-

"*Mechanism alone* (in accordance with Kant) *gives us a real explanation of natural phenomena*, for he traces them back to actual working causes, *to blind and unconsciously working movements*, which are dependent for their existence on the material constitution (nature, character) of the respective natural bodies themselves.

"Since Newton (1682) set up the law of gravitation, and since Kant (1755) fixed the constitution and the mechanical origin of the entire world-structure according to Newtonian principles,—lastly since Laplace (1796) had laid a mathematical foundation for this principle of universal mechanism, the entire inorganic sciences have become purely mechanical, and therewith purely atheistic. . . . *Since then therefore has the conception of purpose disappeared from the whole of this great province*. . . . Now at the end of our nineteenth century, *no naturalist ever ear-*

[1] *E.g.* the ear muscles, the milk-glands of males, the nictitating membrane of the eye, the vermiform extension of the caecum, &c.

[2] "Die Welträthsel," by Prof. E. Haeckel, p. 104-5. The italics are mine.

zehnten Jahrhunderts, *fragt kein Naturforscher mehr im Ernste nach den Zweck irgend einer Erscheinung in diesem ganzen unermesslichen Gebiete.*"

nestly thinks of asking after the purpose of any phenomenon within this whole immeasurable range."

Just as positive is Haeckel as regards the organic world :—

"Der blinde 'Kampf um's Dasein zwischen den Organen' bedingt ebenso ihren historischen Untergang, wie er ursprünglich ihre Entstehung und Ausbildung verursachte. *Ein immanenter 'Zweck' spielt dabei "überhaupt gar keine Rolle."*[1]

"The blind 'Fight for Existence between the organs' is just as much the condition of their historical fall as it is of their rise and development. *An immanent 'purpose' plays herein no part at all.*"

He sees no purpose in organs in disuse or dying off, and therefore straight away denies its existence. He cannot see that it is thus we have learned of the existence of change in the building up and development of organic bodies, and that it is the knowledge of this development which has indirectly led to mental development, ethical development ; that it can even give some people the idea of a condition of perpetual imperfection, of a continuous infinite tendency to improvement—in fact the idea of *infinite growth.*

"How can there, in your conception of the universe, be infinite growth ?" some of you will at once ask me. "Did you not say, at the outset, that infinite space was filled to infinity with force; where then is the space in which to grow ?" To this I answer, that just as the blind man hears better than he who can see, *i.e.* one sense is strengthened at the expense of another, so can probably every force-form develop itself at the expense of some other form. Metaphorically, certain force-forms can wither and die that others may live. This can go on without increase of space, it is growth within the same space, it is ideal life, and life to infinity. It is self-maintenance to perfection.

But even if we could not see all this—and very many may not be able to (that a blind man can see nothing is no proof of the non-existence of his surroundings)—if even we do not see a purpose in decay and death, that is in itself no proof that there is no purpose. In fact I have tried to show[2] that such purpose exists.

And what is this purpose ?

To answer this question we shall have to digress for some time, and the answer will require a book to itself.

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[1] "Die Welträthsel," by Prof. E. Haeckel, p. 107.

[2] P. 60 and in this Chapter.

BOOK II

CHAPTER I

LIFE

" Tutte le cose del mondo hamo il termine della vita loro.'
Machiavelli, " Discorsi sopra la prima Deca di Tito Livio," iii. 1.

(Engl. " There is a term allotted for the life of everything in this world.")

WE have seen that the universe is active force. No part of it is perfectly still. Absolute inertia of all and every phase of force in any one part of infinite space is impossible, does not exist.

Now, for the moment, it is not important to know just how and by which exact series of events the at present to us known objective universe came into existence. All that is immediately needed is a knowledge—gained by deduction—that the modes of force distributed through space, at some time within history, so acted and reacted on each other as to produce particles of matter (*vide* p. 78 to the end of the chapter). It is perfectly immaterial for instant purposes to decide whether this matter, at the very outset, assumed the form inorganic or organic; whether this matter at first so moved as is now known to be characteristic of dead bodies, or if the movements were those known as 'life': *i.e.* it is momentarily of no consequence to consider whether living organisms evolved of inorganic mass, or whether living protoplasm broke up into inorganic bodies, or even whether both natures were simultaneously formed, although nearly all probabilities are that inorganic matter was there first—but I anticipate.

Of bodies inorganic or organic not much is known, although probably less of the latter, on account of its great complexity, intricacy, and variability: but even of the former our knowledge is not so great as most people deem. " Hand auf's Herz," we know no more of dead mass, than of the forces in connection with it. We say a body is red, yet we evidently know as much about light as we do of the interelectronic catoptic movements of any material body. We say a body is brittle; but do we know what that means? Do we know what cohesion is? We say a matter is heavy; but do we know what gravity is? Gravity may be the result of many forces working

from without towards a certain direction within. This would produce rotary movement, since no two forces can *actually* meet at a point (*vide* footnote, p. 42). Centripetal action would be set up. An effect of this action might be that all bodies fell to earth, *i.e.* were forced from without, down upon this earth with an accelerated velocity of 32 feet per second; but this is merely a probable hypothesis. We talk about one substance having more or less chemical affinity for another, *i.e.* that it more or less easily forms chemical compounds. But do we really perfectly understand what is meant by chemical affinity? Can any one explain why the atoms of two bodies, each of given characteristics, combine to form a third body with the characteristics of neither of them? Why, and in what wise, for instance, does combustible hydrogen (H) gas combine with oxygen (O) gas, the supporter of combustion, to form a liquid compound called water (H_2O), which has the property of putting flame out? In what relation the atoms or electrons of the one are in contact with those of the other is at present not understood. Is it probable that, as Mr. Beresford Ingram, B.A.,[1] has shown,

> "Combination is only affected when the atoms have taken up a definite position one with another.
>
> "We may suppose an atom to have around it certain regions which are habitable by other atoms, and when the former are occupied by the latter a stable body results."

An oxygen atom[2] is said to have two such valency regions. If now two oxygen atoms are brought together in such a way that one valency region of one oxygen atom comes into intimate contact and coincides with one valency region of the other oxygen atom, then the region referred to is rendered uninhabitable; and the two oxygen atoms are held together with a given force, and since hydrogen has only one valency region, one atom of hydrogen attaches itself to each still uninhabited oxygen valency region, and we get H_2O_2. On the other hand, one atom of oxygen can combine with two of hydrogen and we get H_2O.

Or is it that, being but a conglomeration of force centres, both hydrogen and oxygen, on flame being applied, cease to exist as matter, but, owing to surrounding force-stress conditions, certain forces again take substantial form as water?

Or is it that one of the constituent elements of the burning gas, giving the flame, draws on to it a ring or sphere of electrons of either

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[1] *Vide* "Knowledge and Scientific News," for April, 1905; pub. King, Sell & Olding, Ltd., London.

[2] These words are said by Mr. Ingram of the carbon atom.

the hydrogen or oxygen, after the manner hinted at by Mr. Ingram [1] for the transmutation of sodium to lithium ?

Or that during the combustion of hydrogen, under the assistance of oxygen, there be the mechanical absorption of a third element,[2] but this latter to such an infinitesimal degree as to be physically or chemically undetectable ?

Or lastly, may it not be, that the hydrogen and oxygen in combining to water have, under the influence of heat or flame, attracted to them only a part of one of these elements—a sphere of electrons, which, on the application of the electric current (electrolysis), is again set free ? What would then become of these superfluous electrons need not here trouble us.

But all this has been sheer surmising. Will any one tell me why one substance produces a yellow flame, another a blue one, a third red, and so on ? One knows by experience that the taste of copper, of iron, and of aluminium are all different ; that each of these acts differently on the nerves of the tongue,—but why ? What is the reason that iron, nickel, and cobalt are influenced by a magnet more than lead or gold ?

It is true that mankind adapts inorganic substances to the wants of everyday life, but he, in our days, also makes use of organic matter ; nay more, a man with a certain force called will, can, for his own ends, by hypnotism and suggestion, compel the deeds of another living being—even human—and we use the forces of heat and light direct from the sun to drive motors.[3] But using, and understanding the nature of things, are quite two distinct factors. We use the force called the force of electricity, we even generate it mechanically or chemically, but what is it ? We are, however, beginning to understand something about waves in space, waves of given length and given height and given velocity, so that most likely we shall obtain fuller information as to the nature of the prime forces at an earlier date than that of the conglomeration of them—of so-called matter.

In all, about 100 elementary or prime bodies have, one after the other, been registered ; that is to say, substances which cannot by any existing means be broken up into two or more different components. This conception of an element was first openly given expression to by Robert Boyle (1627-1691).

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[1] *Vide* "Knowledge and Scientific News," for April, 1905.

[2] One of the elemental constituents of the gas, burning which produces the flames.

[3] By the aid of gigantic lenses, machinery for agricultural purposes has been driven in S. America.

Recent science has shown, that certain forms of matter, once thought to be elementary, are made up of several structures possessing distinctive characteristics; such a discovery being each time generally brought about by a new knowledge and adaption of means (the advanced study of chemistry). Again, the study of many bodies has convinced one, that two (as in the case of radium and helium) or more (as in the diamond, soot, carbon, and graphite), having various properties, may actually be different forms of the same element. Lastly, there is no proof to the contrary, that some of the newly discovered elements are not actually of new formation and did not at any comparatively great time ago exist as such. Such a phenomenon would be on a par with the new formation of worlds from nebulæ, and these again from the forces within space. Just so may life be, unseen by us, generated daily in our midst.

Certain elements have been found to combine with certain others in given proportions under known physical conditions. The bodies thus formed are called chemical compounds; and this quality of theirs, *i.e.* their natural characteristics whereby they so unite, is called their chemical affinity, and we say such elements have lesser or greater chemical affinity for certain other elements. Any good text book on inorganic chemistry can further enlighten the reader on this point, as can the two articles 'chemical affinity' and 'chemistry' in an encyclopædia.

Particles of these masses, under certain physical conditions, move around and about each other, unseen to us. Movement occurs in the heating of limestone to quicklime; it takes place when a brass[1] wire is heated or an electric current is sent through it; it appears in radium under normal conditions. The compound of carbon (C), nitrogen (N) and chlorine (Cl), expressed by the chemical symbol $(CN_3)Cl_3$, is a liquid, but becomes solid simply by being kept in a sealed tube. In certain cases, reflection of light may also be due to the intermolecular, interatomic, or even interelectronic motion of polished surfaces. Some of these motions are fairly understood, some indifferently, some not at all.

Now, organic bodies differ in very little from inorganic compounds. They are called organic because they are found in 'living bodies,' *i.e.* in very complex systems of compounds possessing organs or special centres for the promotion and carrying out of certain

[1] A mechanical mixture of the elements copper (Cu) and zinc (Zn).

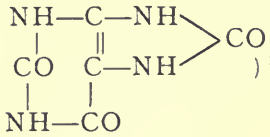
given functions productive for the maintenance of the entire in a 'living' condition. Yet nearly all organic substances are isomeric compounds, built up from the two fundamental inorganic elements, carbon (C) and hydrogen (H), and are thus usually called hydrocarbons. They have though, in many instances, the addition of nitrogen (N) and oxygen (O) and less often also sulphur (S), iron (Fe), phosphorus (P), bromine (Br), chlorine (Cl), potassium (K), sodium (Na), manganese (Mn), calcium (Ca), etc.

Most organic compounds exist without 'life' and very many of them can now be synthetically constructed from the inorganic elements: so that the meaning of the term 'organic,' as applied to chemical compounds, is becoming daily more and more vague.

Thus, towards the middle of the nineteenth century, Friedrich Wöhler built up urea[1] (CH_4N_2O, a carbamide—an amide of the carbonic acids) which, by its production by the decomposition of the nitrogen-containing albumenoids in the animal organism—especially in mammalia,[2] less in birds and reptiles, and traces of which are found even in the blood and most of the tissues, with the exception of muscle—was a discovery of vast importance, as it proved beyond doubt, that organic bodies required no life process for their production. This find was made by the now well-known and much employed system of interatomic substitution :—

$$CO{-}NH{-}NH_3 \ (i.e.\ CH_4N_2O) \rightarrow CO\left\langle\begin{matrix} NH_2 \\ NH_2 \end{matrix}\right. \ (i.e.\ CH_4N_2O).$$ [3]

In certain diseases, the human body discharges its oxygen, turning the urine to uric acid, in its turn producing uric stone and joint swellings. This process of transformation can be carried on in the laboratory, and uric acid ($C_5H_4N_4O_3$ or



) is synthetically producible.

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[1] The essential of urine. Found also in the vegetable kingdom.

[2] Thirty gramme urea are given off by man in twenty-four hours, being 2 to 3 per cent. of the urine. The urine of the horse, cattle, and the pig has about 5 per cent. and they produce 450-600 gramme, 350-450 gramme, and 150-200 gramme respectively. Besides being used as manure, urine is used extensively as an ingredient of the indigo-vat, in cloth-fulling, and in the manufacture of orchal (litmus). These processes being unhealthy, and the supply limited, there appears a large field open for artificial urea. Disgusting as it may sound to the prejudiced, urea, artificially prepared, would give a racy flavour to Swiss and certain other cheeses.

[3] Urea is artificially made by vaporising an aqueous solution of ammonium cyanate. Several other methods are known.

Since Wöhler's day, such substances as spirits of wine (ethyl alcohol C_2H_5OH), grape sugar ($C_6H_{12}O_6$), indigo ($C_{16}H_{10}N_2O_2$), and the acids which give our apples, lemons, and grapes such a refreshing taste, and even the remarkable aetherial substances which impart to the same their lovely aroma—complicated though they are—have been constructed bit by bit, built up atom for atom from the free elements, carbon, hydrogen, and oxygen.

Yet more! As Karl Oppenheimer, in the 'Berliner Tageblatt' (1903), poetically expresses himself as regards the chemist of to-day:—

"Zauberisch baut er die Fette auf: dieselben Fette, die im Hocker des Bison, im Euter der Kuh der Lebensprozess erzeugt."

"Magically he builds up the fats; the same fats which are produced by the process of life in the hump of the bison and the udder of the cow."

It may be added, that human fat is a mechanical mixture of palmitic acid ($C_{15}H_{31}{\cdot}CO_2H$), stearic acid ($C_{17}H_{35}{\cdot}CO_2H$) and oleïc acid [$H(C_{18}H_{33})O_2$], in combination with glycerine [$C_3H_5(OH)_3$].

'With the addition of nitrogen,' Herr Oppenheimer further informs us, Ladenburg synthetically put together the parts of the hemlock's virulent poison, conine. In the original stands verbally "Er ninnt zu den drei Grundstoffen noch den Stickstoff hinzu." (Engl. "He takes nitrogen to the three fundamental substances.") Now conine is represented by the formula $C_8H_{17}N$, so that Herr Oppenheimer is technically wrong, for conine is not a compound of C, H, O and N, but of C, H and N. And, as far as I know, it was not Ladenburg but the celebrated Schiff who put together the constituents of conine.[1] Whether or no Ladenburg may not synthetically have set up conhydrine ($C_8H_{17}NO$), an alkaloid, also found in hemp, I do not know. But in such and like wise other organic compounds, far too numerous to mention, now owe their existence to the concoctions of the laboratory.[2]

But there is one substance or class of substances which has as

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[1] *Vide* also art. 'Hemlock' in "Chambers' Encyclopædia."

[2] Of interest are β-methyl-glucoside formed in plants, leucine [α-amido-saproic acid $CH_3{\cdot}(CH_2)_3{\cdot}CH(NH_2){\cdot}CO_2H$] found in the brain, spleen, and pancreas; taurine (amido-isothionic acid $C_2H_4\left\langle\begin{matrix}SO_3H\\NH_2\end{matrix}\right.$) in the bile of the ox and many other animals, glycocoll, hippuric acid, sarcosine, xanthine, caffeïne, theïne, the dyes, and so on. It is perhaps worth while noting that whereas the dextro-rotatory α-methyl-glucoside is easily attackable by the enzyme yeast, β-methyl-glucoside is not, which fact is of the greatest importance for the maintenance of plant life. In making hippuric acid we are copying a natural life process, for it is formed in the urine of flesh-eaters by the action of phenyl-propionic acid which results from the putrefaction of proteids in the alimentary tract (*vide* "Berichte der deutschen chemischen Gesellschaft," 12,648, art. by Salkowski, and the "Zeitschrift für Biologie," 22,236, art. by Tappenier.

yet eluded the grasp of the expert, a substance found in every mass capable of life, but as far as is known, in such bodies only—albumen or the albuminous bodies.

These bodies are also known as proteids and are complex compounds, or rather a mixture and partly simpler compounds, the constituents of which are C, H, N, S, O. Bodies containing gelatin, mucin, etc., in combination with proteids are called albuminoids, but all such bodies "are united by a close genetic relationship" (Watts' "Dictionary of Chemistry").

According to Hoppe-Seyler,[1] proteids vary from

C	H	N	S	O
51.5	6.9	15.2	0.3	20.9
54.5	7.3	17.0	2.0	23.5

Vegetable albumen has been separated from rye by Jones (Liebig's 'Annales der Chemie,' 40, 66), from wheat flower by Dumas ('Annales de Chimie et de Physique,' [3] vi.), from potatoes by Ruling (Liebig's Annalen, 58, 306), from the latex of several caout-chouc-yielding plants (Apocyneæ and Sapotaceæ), by J. R. Green (Proceedings of the Royal Society, xl. 28), and from manihot (Euphorbiaceæ) and the common lettuce (Compositæ).[2]

It is from albumen that urea is derived, and as Schutzenberger was able to break up albumen into its components, ammonia (NH_3) and carbonic anhydride (CO_2) in the same proportion as in urea, he came to the very natural conclusion that in albumen he had found a ureïde of very complicated structure. Thus, Lieberkühn says that when albumen is decomposed by caustic baryta, it breaks up into urea, acetic acid, a sulphur-containing substance and a body which can be represented by the formula $C_{68}H_{132}N_{14}O_{24}$ and which can, by hydration, be further split up.

In no two instances are naturally all conditions, under which substances are formed, exactly similar. If you find two mountain crystals, you can soon observe that through mechanical mixing they differ either in colour or structure. They vary also in shape, in size, in hardness, in lustre, in their refractive indices and the like more. Yet we can analyse them and reconstruct some of them, though not all. We cannot obtain the heat necessary to the formation of some nor the pressure requisite to others, whilst the want of suitable apparatus and machinery, found alone in nature's workshops, is the

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[1] "Handbuch d. Phys. und Path. Chem. Analyse," 4th ed., p. 223.

[2] "Chemical Physiology and Pathology," p. 131-132, by Prof. W. D. Hall'burton Longman, Green & Co., 1891.

cause of non-success in a third group and so on. There are gases locked away deep down in the caverns of the earth of whose exact constituent parts we shall ever be probably in ignorance. This is not because there is anything supernatural about them, but because they exist under pressure. As soon as they reach parts of the earth's crust where this pressure is diminished, they break up into two or more parts quite unlike the original. Some, again, suddenly form new chemical compounds with the oxygen and other gases of the atmosphere. There are inorganic bodies so volatile that they cannot long be kept in existence and soon, despite all precaution, break up into their components. It is therefore perfectly conceivable that substances may come into existence, and yet break up so rapidly again that there is no time to study them. These may however, form, with other elements or compounds, stable bodies, or such which are continually changing their internal structure without it at once becoming evident.

So too, is it probably with albumen and the albuminous bodies: they have never been synthetically put together because their structure could never be fixed: they are in part mechanical mixtures[1] of several compounds varying in number and quantity (most likely some very unstable ones) and are in a state of constant flux or internal change. Most probably too, there are individuals or combinations which are acting as ferments. The nature of these functions will be seen anon. But just as no two cats are entirely alike and it is yet possible to determine which animals are cats and which are not, so too, can one detect which chemical formulæ represent albumen and which do not. There may be two or three different albumens just as there are many proteids.

Although the symbol for albumen has been variously fixed, the result is in each case near enough to enable one to recognise the nature of the body so described.

Thus, in J. M. Baldwin's "Dictionary of Philosophy," we find the formula $C_{72}H_{106}N_{18}SO_{22}$ whilst in Otto Lueger's "Lexikon der Gesamten Technik"[2] it stands $C_{720}H_{1134}N_{218}S_5O_{248}$, which is given for albumen in crystalline form. Lieberkühn gives us a formula $C_{72}H_{112}N_{18}SO_{22}$, which differs from Baldwin's only by H_6 or $3H_2$. On closer examination we see that Lueger's formula is approximately

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[1] We find such mechanical mixtures in a piece of flint, in petroleum, osokerite, in the resin of plants, and the like more.

[2] Pub. "Deutsche-Verlags Anstalt," Stuttgart und Leipzig. *Vide* art. in vol. iii., on 'Eiweisstoffe,' by Dr. W. Kerp, Assistant Teacher to Göttingen University.

ten times[1] Baldwin's, *i.e.* $C_{720}H_{1060}N_{180}S_5O_{220}$[2] + $H_{74}N_{38}O_{28}$, so that we can now write either of the two equations,—

(*a*) $3(C_{720}H_{1134}N_{218}S_5O_{248}) = 3(C_{720}H_{1060}N_{180}S_5O_{220}) + 84H_2O$[3] $+ 18NH_3 + 32N_3$.

(*β*) $2(C_{720}H_{1134}N_{218}S_5O_{248}) = 2(C_{720}H_{1060}N_{180}S_5O_{220}) + 56H_2O + 10NH_3 + 3H + 11N_3$,

whilst by shifting S on the right side of the equation, we would write—

(*γ*) $6(C_{720}H_{1134}N_{218}S_5O_{248}) = 6(C_{720}H_{1060}N_{180}S_5O_{220}) + 168H_2O + 18\,[(NH_4)HS]$[4] $+ 6H_2S + 3H_2 + 3S_2 + 70N_3$,

and I do think that ammonic sulphydrate is a component of albumen.

The difference between Dr. Kerp's and Prof. Baldwin's formula, after allowing for 28 molecules of water of crystallisation and a slight variation in the quantity of sulphur, is therefore only $H_{18}N_{38}$, which means actually more NH_3 or NH_4 and a large proportion of free nitrogen. This last is easily accounted for when we know that Dr. Kerp's analysis is based on vegetable albumen,[5] whilst Prof. Baldwin, or rather Prof. Baldwin's authority, obtained his results from animal albumen, because it is well known that plants contain more nitrogen and compounds of nitrogen than animals, although they have less albumen. In fact, ~~all~~ most animal albumen now comes in the first instance from the vegetable kingdom,[6] which alone is the great factory thereof, and ~~alone~~ possesses the connections necessary for procuring sufficient supplies of nitrogen from the air-chamber of Nature's storehouse.

There are, however, exceptions to this to be found in the carnivorous plants,

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[1] That the formulæ of organic compounds are often expressed in multiples of an original is nothing new, and is simply due to the fact that chemists, although agreeing to the proportion in which the elements combine, have not yet arrived at any mutual conclusion as to the number of atoms to the molecule. Thus the formula for cellulose, which forms the staple of nearly all the tissues of individuals in both the animal and the vegetable kingdoms is given by Payen and also by Remsen ("Organic Chemistry," by Prof. Ira Remsen, pp. 185 and 187; Macmillan & Co., London, 1886) as $C_6H_{10}O_5$, the same as for the isomeride starch, or $C_{12}H_{20}O_{10}$ by Mitcherlich and Gerhardt (*vide* Gmelin's "Handbuch der Chemie," vol. vii.), which is actually $2(C_6H_{10}O_5)$, or lastly as $(C_6H_{10}O_5)x$ by E. Schulze (*vide* "Ueber die Cellulose," in the "Chemische Zeitung" for 1895, vol. xix., pp. 1465-1467), where the factor x stands for any number whatsoever.

[2] This difference in the amount of sulphur present, *i.e.* a deficit of S_4 is probably due to the mechanical mixture of this element in a condition of fume It is one of the elements which vary the most in given formulæ of the albumina, and varies probably with the temperature and pressure at which the given albuminous body was formed.

[3] So-called 'water of crystallisation.'

[4] Ammonic sulphydrate is sometimes called ammonic sulphide.

[5] Only vegetable albumen has been crystallised. Crystalline vitellin is often falsely called crystalline albumin, but vitellin is a globulin.

[6] As, however, there is little albumen in plants, animals have, either themselves to eat much vegetable matter, or devour animals that do so.

"and in parasitic plants which live upon the materials found by other plants. . . . . In the carnivorous plants (*Drossera*, *Dionæa*, *etc.*), a juice is secreted which has the power of converting into peptones the proteid matter in the flies and other small creatures caught by the plants." [1]

"The assimilation of proteid food [2] is looked upon by Pflüger as an ether-like combination, as a molecule of living proteid with one of the non-living proteids, water being eliminated. This union of isomeric molecules, which forms a heavy mass but still remains a single molecule, may be conceived to go on indefinitely. In this process it seems probable that the nitrogen of the food proteid, which exists there in combination as amides, passes into combination with carbon, so that in living proteid it is combined in the form of cyanogen." [3]

This interchange of matter in the two kingdoms, vegetable and animal, is illustrated by Prof. Dubois Reymond, as shown on p. 127.[4] The absorption of nitrogen by vegetable matter is clearly shown on the right hand side.

"Chambers' Encyclopædia" gives us the information that there is no hard and fast line between the animal and vegetable kingdoms any more than there is between organic and inorganic matter. *E.g.*

"Muscle-sugar, peptic and diastatic ferments are of frequent occurrence in the vegetable kingdom,"

whilst cellulose, chlorophyll and starch are incidentally met with among animals. Allantoin,

"An important waste product of the vertebrate embryo, is also found in quantity in opening buds in spring . . . . while pepsin can be obtained alike from the stomach, from the plasmodium of a myxomycete, or from the digestive secretions of an insectivorous plant."

At this point it may be interesting to note that one of the bodies which are concerned in the building up of the proteids—asparagine $[C_4H_8N_2O_3 + H_2O \text{ or } C_2H_3(NH_2)\left\langle\begin{matrix}CONH_2\\CO_2H\end{matrix}\right.]$ —is formed by inorganic nitrogen compounds + malic acid $[C_4H_6O_5 \text{ or } C_2H_3(OH)\left\langle\begin{matrix}CO_2H\\CO_2H\end{matrix}\right.$ —itself synthetically formable from inorganic matter] in the plant; and later from the carbohydrates $(C + H_2O)$ under the influence of chlorophyll.

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[1] Halliburton's "Chemical Physiology and Pathology," p. 136. Prof. Halliburton refers one also to Darwin's "Carnivorous Plants," and the art. 'Carniv. Plants' by P. Geddes, in the "Encyclopædia Britannica."

[2] In plants (as nourishment) and animals (as food).

[3] *Vide* art. 'Proteid,' by Prof. W. D. Halliburton, M.D., in Watts' "Dictionary of Chemistry," for which see more on this subject.

[4] The following schema was taken down from the black-board at one of Prof. Reymond's lectures in the summer of 1887.

THE CIRCULAR* PATH OF MATTER IN ORGANIC NATURE

the **Animal**

liberated from the Protoplasm

with ***inner*** roots

An automatic Oxydation's Apparatus

a Constituent of Plants (organic compounds)

and gives back air and earth

in inorganic form.

It takes up:—

(1) ***Egg-white bodies***
(2) ***Hydro-carbons***
(3) ***Fats***
} and oxygen

and sets chemical tension into living power,—as muscle, contraction, and heat

and falls to CO_2 H_2O NH_4O

Metamorphosis

Deterioration ↙ ↖ Progression

Metamorphosis

and oxygen
(3) ***Fats***
(2) ***Carbo-hydrates***
(1) ***Egg-white bodies***

It sets free

light into chemical tension, the living power of the sun's and *Nitrogen* and as it sets

It takes up CO_2 H_2O NH_4O

the **Plants**

Seeds hanging on to the Pods

with ***outward*** roots

A moveless[2] Reduction's Apparatus

A Constituent of the Air and Earth (inorganic Compounds)

and gives it back to the Animal

in organic form.

---

[2] It cannot be absolutely moveless any more than any other object. Moreover, there is chemical action going on all the time, and this too implies movement. Lastly, it must not be forgotten that not all plants are even stationary; very many vegetable organisms are, in the earliest stages of their existence, free-swimming, whilst even a few are motile or float even in adult life.

Circular used here for want of a better word. There is no proof, nor is i

Bearing in mind that Siedendopf[1] makes it possible to see a smooth surface of 0.000006mm^2, it can be approximated that the minute cube of space represented by 0.000006mm^3 contains about 190,150 molecules of albumen. And this little molecule of albumen, how did it come into existence, and when? Found now in all life,

"von der Monere an, die einzellig die Ozeane der Vorzeit bewohnte, bis zu den ungeheuren Riesensauriern der Steinkohlenwälder, bis zur Mammuthskiefer Kaliforniens,"[2]

"from the monad that as unicellular mass inhabited the oceans of primeval times, to the enormous gigantic saurians of the forests of the coal periods, to the mammoth firs of California,"

it most probably originally came into existence inorganically, *i.e.* has formed directly from 'dead' mass, from the elements or their inorganic compounds. We can even guess at the temperature at which the formation took place, for it is known that egg-white bodies coagulate at no very great heat.

The temperature of our globe must therefore have been considerably below the boiling point of water. But at present we do not know whether albumen was moulded by nature under conditions not now prevailing, or if it is synthetically made up before our very eyes, without us, however, being able to detect it from that biologically originated, which latter is the more probable.[3]

Be that as it may, the synthesis of albumen still remains an unsolved problem. Constituents, volatile in themselves, so loosely built up that they are liable to change of molecular structure at the slightest touch, yet with such a power of assimilating with other constituents that they can, when once united, only with the greatest difficulty be separated and are thus able to maintain their friendship under the tense strain of the combination of forces which we call 'life'—

"nur ein aus äusserst vielen Atomen zusammengesetztes gigantisches Molekül kann den, aus mächtigen, in sich verklammerten, Quadern gefügten, stabilen Kern besitzen, der selbst starken äusseren Einflüssen wiedersteht; und der sozusagen mit seinen Anhängseln, mit kleineren Atomkomplexen verbunden ist, die

"only a gigantic molecule made up of an exceedingly vast number of atoms can possess the stable core of huge blocks, so clamped and joined together, as to withstand even a strong influence from without; and is yet coupled, so to say, with appendages, with smaller complex groups of atoms which react on

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[1] *Vide* footnote to p. 56.

[2] Carl Oppenheimer.

[3] *Vide* Martin's theory on p. 129.

ihrerseits auf die leisesten Reize reagiren. So steht der mächtige Glockenthurm der chinesischen Städte selbst im Erdbeben aufrecht, ohne dass sein Quadergefüge sich löst und doch genügt der leiseste Windhauch, um die kleinen Glöckchen an seinem First zum Ertönen zu bringen."

the slightest excitation (stimulation). Thus does the mighty belfry tower of the Chinese towns stand even in an earthquake upright without that the jointing of its blocks be loosened, and yet does the softest breath of wind suffice to tingle the tiny bells around its edge."

—these, and the facts of mechanical mixture and our ignorance as to the ways and means, these and others are the difficulties which have to be surmounted.

And here I must call your attention to a recent capital article by Godfrey Martin, B.Sc., which ought to be read *in extenso*, entitled, "The Nature of Life,"[1] which places Oppenheim's beautiful picture of the atomic structure of the albumen molecule on a scientific basis. Martin shows :—

> "that above a certain definite temperature depending on the nature of the molecule,[2] *no pressure, however great, can prevent the substance from completely decomposing.* This temperature and pressure, above which a compound is incapable of existing, we will call the critical temperature and pressure of decomposition."

He continues :—

> "The critical temperature and pressure of decomposition of even very unstable compounds is usually very high. . . . In general, the smaller the number of atoms in the molecule of a compound, the higher is its critical temperature of decomposition ; whereas the greater the number of atoms, the lower the critical temperature . . . if now . . . we proceed to steadily add on atoms to a molecule so as to make it more and more complex, we steadily lower its critical temperature of decomposition. . . . We could reduce the critical temperature and pressure of the compound until they *coïncided with the normal temperatures and pressures which hold upon the earth's surface.*
>
> "Such a compound would be possessed of an extraordinary sensitiveness to external influences, on account of the sharpness of the constants called above the critical temperature and pressure of the compound. A slight increase of temperature, or a slight decrease of pressure, would serve to throw it into a condition of rapid chemical decomposition ; whereas a slight increase of pressure and decrease of temperature would cause the substance to suddenly cease to decompose.
>
> "In order to generate such a complex compound, we must first take

[1] *Vide* "Knowledge and Scientific News" for June, July, and August, 1905.

[2] Of any substance.

as the central atom an atom capable of exerting a high grade of valence, and possessing a well-developed power of self-combination."

After proving that carbon possesses these qualities in high degree, Martin goes on to show that H, O, N, S, P, are elements able to combine with C in the way and under the conditions described, and that these are the constituents of albumen.

I believe we can even get to see somewhat what a molecule of albumen looks like. Beresford Ingram, B.A.,[1] tells us that all atoms, of whatsoever element, contain electrons of varying numbers which arrange themselves as a nucleus surrounded by a number of hollow spheres. Exactly what these numbers are he does not inform us. But, says he, in writing of this electronic arrangement:—

"This is, to some extent, experimentally demonstrated by taking some short, thin rods of steel and magnetising them. They are then stuck through corks, and so arranged that when placed in water they will float perpendicularly with their north poles uppermost out of the water. In this way the magnets can move in one plane only, *i.e.* that of the surface of the water; but it must be borne in mind that the corpuscles composing an atom are assumed to be free to move in any one direction. They will therefore form hollow spheres.

"When two such magnets are placed in water, they of course assume some position apart from one another; three form an equilateral triangle, four form a square, five form a circle with the magnets at equal distances from one another, six form a circle with one in the middle. The following list shows how the magnets would arrange themselves when thrown indiscriminately into the water, from which we conclude that such is their position or arrangement of equilibrium.

No. of magnets	5, 7, 8, 9, 11, 13, 19, 23, 30, 36 . . . 272.
Outer ring . .	5, 6, 7, 8, 9, 10, 12, 13, 15, 16 . . . 40.
Inner ring . .	0, 1, 1, 1, 2, 3, 7, 10, 15, 20 . . . 232."

Now although, in flights of scientific fancy, an electron has been described as a thousand million or more times smaller than an atom, I would rather endorse the idea of that musical and harmonious soul, Newman Howard,[2] who accepts Prof. J. J. Thomson's 1,000 corpuscles or electrons for a hydrogen atom, and for every other element a number corresponding to 1,000 times the atomic weight of the element in question. Thus an atom of

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[1] *Vide* art. 'Ad Infinitum,' by Beresford Ingram, B.A., in "Knowledge and Scientific News" for April, 1905.

[2] *Vide* art. 'Warp of the World,' by Newman Howard, in the "Hibbert Journal" for January, 1905.

Carbon	(C)	would	have	12 × 1,000	electrons.
Nitrogen	(N)	,,	,,	14 × 1,000	,,
Oxygen	(O)	,,	,,	16 × 1,000	,,
Sulphur	(S)	,,	,,	23 × 1,000	,,

This of course will not hold good for compounds. *E.g.* the atomic weight of H_2S is 34, but reckon as you will, an atom of H_2S has not 34,000 electrons—unless, for which I at present see no reason, there be assumption of metamorphosis—both H and S losing their identity and producing a substance far more finely divided in structure, *i.e.* with smaller grain. But most probably H_2S has very much less, since, on our reckoning, an entire molecule has only

H S

$2 \times 1{,}000 + 1 \times 23{,}000 = 25{,}000$ electrons, giving us 8,333·3 corpuscles to the atom. As it is impossible, in the ordinary way, to conceive of an atom as containing the odd fraction of an electron, this would go far to support my surmise (*vide* p. 118) that even the electrons entirely give up their individuality when combining to form a compound body.

"The arrangement," says Ingram,

> "is found to be more stable the greater the number of magnets within the inner ring."

This too, most likely, pertains to electronic groups.

If therefore we take carbon as our central body in a molecule of albumen, it must, to be stable, have more electrons in the inner than in the outer ring.

That this is the case the following table shows:—

Element		No. of Atoms $[C_{72}H_{106}N_{18}SO_{22}]$		Atomic Weight				No. of Electrons
C	=	72	×	12	×	1000	=	864,000
H	=	106	×	1	×	1000	=	106,000
N	=	18	×	14	×	1000	=	252,000
S	=	1	×	23	×	1000	=	23,000
O	=	22	×	16	×	1000	=	352,000

for there are 864,000 carbon electrons as against 733,000 electrons of all the other elements put together. But not for a moment must it be thought that each carbon electron has the capacity of attracting an electron of H, N, O, or S. C is a tetrad, that is to say, the valency of C is four, or in other words, each C atom, *i.e.* each 12,000 electrons, can attract 4 atoms (4,000 electrons) of H (monad or valency : 1), or two atoms (32,000 electrons) of O (dyad or valency : 2), or 2 atoms (46,000 electrons) of sulphur

(dyad or valency : 2), or lastly, 3 atoms of C (36,000 electrons) can attract 4 atoms (56,000 electrons) of N (triad or valency : 3).[1]

As the valency of C is 4, there are, in a molecule of albumen, $72 \times 4 = 288$ valency regions. Against this there are

	No. of Atoms		Quanti-valence		
106 atoms of H with	106	×	1	=	106 valency regions
18 ,, ,, N ,, (valency 3)	18	×	3	=	54 ,, ,,
22 ,, ,, O with	22	×	2	=	44 ,, ,,
1 ,, ,, S ,, (valency 2)	1	×	2	=	2 ,, ,,
giving a total of					206 valency regions

or attractive parts among all the other constituent elements, leaving a balance of 82 carbon valency regions to unite among themselves.[2] Most probably, actually some of the hydrogen valency regions are combining among themselves and with the oxygen, the nitrogen, and the sulphur regions ; in which case, of course, whilst increasing the intricacy and delicacy of the outer structure, there would be an increase in the number of carbon valency regions which would unite among themselves. Probably the number would be 94, leaving 194 valency regions to combine with the other elements.

We are drawing very near to Carl Oppenheimer's charming analogy of the Chinese pagoda, those H, N, O, S electrons, which are not under the direct influence of the carbon valency regions, going to form the structures H_2S, NH_3, H_2O, which represent the tinkling bells about its edge. There will nevertheless be a larger number of free carbon valency regions to unite with other elements than to combine among themselves: so that though the carbon centre, as regards numbers of electrons, is a stable condition (having a greater number in the inner spheres),[3] it may probably, as regards equivalency, be unstable—having more valency regions without than within—so that a carbon valency region at one moment combined with another, is the next free to join one of the outside groups, say oxygen; wherefore, with all due humility, I proffer this as a part-solution to the problem of the metabolism of protoplasm. May it

[1] As N is here a triad and not a pentad (valency : 5) four of its atoms probably combine with three atoms of the tetrad, carbon. A molecule of cyanogen would in this case be constructed from $\frac{3}{4}$ molecule of C + 1 molecule of N.

[2] *Vide* Ingram's art. in "Knowledge" for April, 1905.

[3] More electrons within than without, is a structure which might be expected in a body about to crystallise. There are 864,000 carbon electrons as against 633,000 electrons of all the other elements put together.

not, to some extent, account for such actions as the fermentation of hæmoglobin to oxyhæmoglobin and back again, and so on.

At all events, I hope my rough illustration (Fig. 7) will, in some degree, give the reader an idea of what is going on in a molecule of albumen.

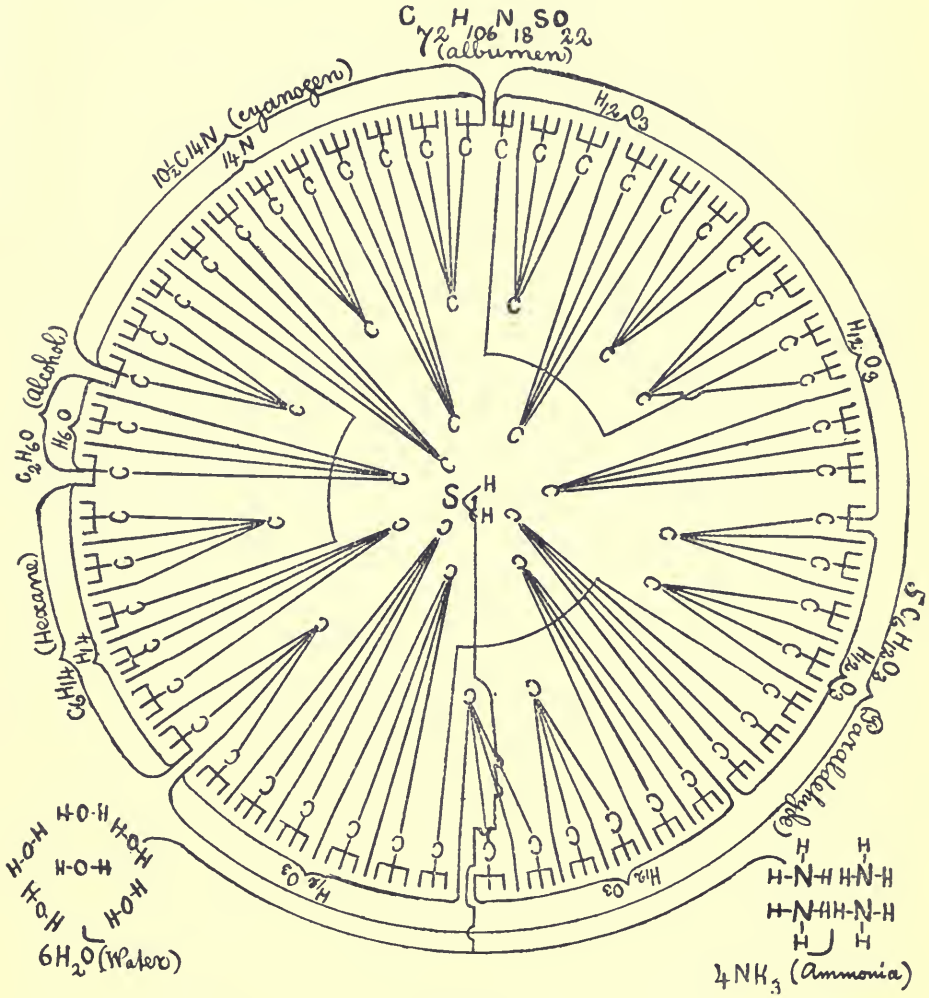

Fig. 7

Instead of the proverbial "storm in a tea-cup," we have 1,597,000 electrons swiftly whirling about in numerous vorticæ, firstly among themselves and then in another spiral vortex as a whole, and all this double-motioned wild gyration within a minute space represented roughly by 0.000,000,000,000,000,000,013mm.[1]

[1] *Vide* p. 127.

If we apply the same process to ascertain the number of electrons in a molecule of hæmoglobin ($C_{600}H_{960}N_{154}F_1S_3O_{179}$), as shown in the following table :—

Element		No. of Atoms		Atomic Weight				No. of Electrons
C	=	600	×	12	×	1000	=	7,200,000
H	=	960	×	1	×	1000	=	960,000
N	=	154	×	14	×	1000	=	2,156,000
Fe	=	1	×	56	×	5000	=	56,000
S	=	3	×	23	×	1000	=	69,000
O	=	179	×	16	×	1000	=	2,864,000
						Total		13,305,000

we shall find that the number of carbon electrons, viz. 7,200,000, bears practically the same ratio to the total number of electrons in the molecule, namely 13,305,000 as the number of carbon electrons in the albumen molecule (864,000) bore to the total amount (1,597,000) of that molecule. It would be perhaps worth while to study whether any importance should be laid on this fact.

It may be, of course, that it took years, or even ages, to form albumen, and that therefore we can never hope for success: but to this idea I do not lean, for most things are more rapidly manufactured in the laboratory than they are produced in nature.

At all events, our momentary inability is no proof of ultimate failure—is no proof of the absolute impossibility.

> "The inability of observers in the past to perform an experiment may be from lack of means or knowledge." [1]

Yet religious leaders of all creeds and denominations and their minions have ever, as their only nourishment, ransacked the chemist's kitchen, scraped together all his waste, and in an admixture of oil and fat of their own concoction, they prepare a 'bubble and squeak' [2] which, as often as not, even contains that which the chemist has tried in vain himself to digest.[3]

But there are, alas, some people who will swallow anything. They trust any cook, without asking after his credentials, or troubling about his character. This kind of cooking is of course very saving in the theological household, and reduces the expense of thinking to a minimum—a luxury, by-the-bye, not often indulged in. The fact

[1] "Chemical Physiology and Pathology," by Halliburton, p. 154.

[2] A nauseous household old-time receipt for economising with kitchen waste.

[3] Of course metaphorically, *i.e.* mentally.

is that, with few exceptions, although there are many theologians and their pupils who have been expositors of one or more branches of science, there are few who have to any great extent, advanced it, or have in any way been initiatory.

In the days gone by, it was ever church *versus* science. Any exceptions brought forward will not annul the rule.

And then again, there are men like S. B. G. McKinney, great author and profound, of the "Origin and Nature of Man."[1] He does not bubble nor squeak; or is it that the depth to which he dives is so great that the squeaking is not heard?

I leave this to the public. But is it not ungenerous for McKinney to write of Spencer:—

> "By the employment of a multitude of words, not generally understood, he led the simple to suppose that there was some sound sense beneath his language, and that something could be produced by nothing if there was only added the processes of integration, differentiation, reconstruction, and the spontaneous evolution of organised heterogeneity. The simple fact remains, that what is homogeneous will not begin to move of itself; and if it begins to move of itself it is not homogeneous."[2]

Now, although I cannot agree with Spencer much, I do believe in his sincerity, and that it is an unwarrantable aspersion on his character to make him pose as one, by long words, playing on the credulity of the simple.

Moreover, Spencer did not write for the masses, who would probably not have understood him, nor, for that matter, for philosophasters, but for philosophers and other really thinking individuals.

It is moreover actually incorrect to assert that Spencer declared it in any way possible to produce something with nothing.

Mr. McKinney is probably referring to an already cited (p. 80 of his work) paragraph in Herbert Spencer's "First Principles":—

> "Evolution is an integration of matter and comitant dissipation of motion, during which the matter passes from indefinite, incoherent homogeneity to a definite, coherent heterogeneity; and during which the retained motion undergoes a parallel transformation."

The reader will notice that Spencer does not say at all what caused the integration of matter and thus started motion. Without momentarily stopping to search for a first cause, he merely stated

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[1] Pub. in six parts by Oliphant, Anderson & Ferrier, London, 1904.

[2] *Ibid.*, part i., p. 85.

his supposition that matter was once homogeneously diffused, and later got into motion. Moreover Spencer says clearly, "Evolution is an integration of matter." He is speaking of the movements of matter when existing, he is not speaking of how it came into existence. He does not say either that it put itself or that it was put in motion.

As, however, according to what I have tried to show, there never was a state of perfect homogeneity (a view borne out by many others than myself)—Spencer was here probably wrong; so that McKinney would be tilting at a windmill.

This, my standpoint, is borne out by a statement in Spencer's Essays,[1] a statement with which I *in toto* disagree: that the development of a tree from a seed or an animal from an ovum constitutes

> "an advance from homogeneity of structure to heterogeneity of structure. In its primary stage, every germ consists of a substance that is uniform throughout, both in texture and chemical composition. The first step is the appearance of a difference between two parts of this substance; or, as the phenomenon is called in physiological language, a differentiation."

Here too, no question is raised as to how the germ came into existence. As it seems to me, perfectly without warranty, Spencer assumes or takes for granted a state of homogeneity in the germ or original cell. This were a wonder indeed. How does he account for the fact that two boys, by one pair of parents, have at birth and even in the womb, and most likely even before this again, different characteristics?

The environment in and about the womb is not sufficient to account for these marked variations. The ovum and spermatozoon, before conjugation, were decidedly different in each case. As a body is built up of layers of cells by degrees (as I show on pp. 154 and 169-171), so too, the ovary cells did not come spontaneously or simultaneously into existence but by degrees, and ripened by degrees at a known rate.

By the time the second ovum ripened, the environment is different to that obtaining during the growth of the first ovum, which itself owed existence to masses and free forces in a state of continuous flux. The constitution, texture, and chemical composition of the second ovum cannot be exactly that of the first, since environment due to chemical agency, intercellular physical action, the character

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[1] "Essays: Scientific, Political and Speculative," by Herbert Spencer, vol. i., p. 9, library edition; pub. by Williams & Norgate, 14, Henrietta Street, London, 1891.

and temperament of the mother—which is again influenced from both internal cause and external environment[1]—mode of life, etc., was perpetually changing. For this very same reason, the ovum itself is not uniform, although neither our instruments nor our senses may be able to detect any difference. But even seen through a microscope, the ovum or even any other prime cell or cellular mass is not *absolutely* homogeneous.

There are, *de facto*, dark and light markings, thick and thin parts, which will no doubt, by improvements in our instruments of research, be shown to be due to environmental influence; but they are there, and the whole cell itself was never still, but continuously in motion from the time it formed itself from the inorganic elements[2] to the time of its full growth and fertilisation. It never was homogeneous.

Homogeneity does not, and never did exist; its conception is a hallucination.

It is also a most common hallucination to conceive the rider hereto, that there ever was a beginning to differentiation. *There never was a time when differentiation started, for, as infinite force is in eternal motion, differentiation went on and will go on to infinity.*

This last sentence wants some closer defining. Differentiation, as a quality of the all-pervading force, is infinite; but as a quality of the special bound-up force-forms, which are in evidence as matter, it is co-existent with matter, beginning therewith and ending therewith. It is a real abstraction, and the conception thereof is a real abstract conception.

The force or combination of forces producing the state of differentiation really exists. It is a reality, and the conception thereof a real conception.

But not only against Spencer, but against all truly great biologists and physiologists is the tirade. On p. 39 of part i., in order to make their words laughable, McKinney writes:—

> "In response to our inquiries as to the manner in which man originates we have our vision obscured and our intellect stupefied by a lecture that seems to tell us that the spongioplasm and the hyaloplasm of the protoplasm rock the cradle of the nucleus by their spontaneous amœboid movements, until the sleeping man within the nucleus hears the cry of karyokinesis, and awakes to an appreciation of all the wonderful mitoses he has to undergo, and, in his struggle for development, employs his achromatic spindle to arrange the

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[1] Changing infinitely, as shown at an early stage of this work.

[2] The inorganic elements are again, as I have shown, a mode of ever moving force. (*Vide* pp. 78, 79.)

chromosomes, so as to form the monaster preparatory to the metakinesis, in which the chromosomes are drawn along the fibres of the achromatic spindle into the two separate groups of the dyaster in order to prepare the way for the formation of the daughter nuclei and the production of the complete man by the anabolism and katabolism of the keimplasma."

But no biologist or physiologist would write such a paragraph. The style is not typical. Was it written because McKinney could not himself understand all literature on the subject, or was he trying to be funny? It is not to be expected that the general public of board school education should be able to read the majority of such works, any more than that McKinney should know all the technical expressions of every branch of science, for such knowledge would be truly encyclopædian.

The subjects of higher organic chemistry and biology are so complex, and much of them so new, that special terms have had to be employed.

But this very McKinney, who derides such literature, himself employs expressions which I am sure are not understood by the man in the street. What does the general reader know of protoplasm,[1] ovum,[1] nucleus,[1] potential concentration,[1] physical unit,[1] biophor,[1] chromatic filament,[1] nucleoli,[1] metabolism,[2] zenith,[3] the thyroid gland,[4] or a myxœdematous[4] imbecile, and the like more? And this man who would coin a word 'wision,'[5] a mongrel of Saxon and Latin derivation; who writes so inaccurately,

"The line from the zenith to the level on earth is always a right angle,"[6]

when every schoolboy knows that a line is never an angle, but can form an angle with another line,[7] this man, who appears jealous of

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[1] "Origin of Man," part i., p. 32.

[2] *Ibid.*, part i., p. 35.

[3] *Ibid.*, part ii., p. 55.

[4] *Ibid.*, part iii., p. 32.

[5] *Ibid.*, part iv., p. 13. I have seen this word nowhere else.

[6] *Ibid.*, part iii., p. 55.

[7] A man who is careless about his words is mostly careless in his ideas. Please bear this general truth in mind.

The statement as to the zenith is not so striking an example as was probably intended. The zenith is no special point in the sky, but the point exactly over one's head. Man does not, first of all, accognise a zenith, then drop a plumb-line, and find it, *mirabile dictu*, make a right angle with the earth's tangent through the point on which he was standing; but reversely, he mentally draws a line, a tangent, at right angles to his position when standing straight; which position is, as I have elsewhere shown, one gained by experience, *i.e.* by the use of one's sense or senses. Having done this, he prolongs mentally the axial line through his body to the limit of vision. The furthest point he conceives as lying in the heavens among the stars, and calls it the zenith. An axial prolongation in an opposite direction gives him the 'nadir.' But at one moment no two people can have absolutely the same zenith or nadir, for they are standing at different places, so that there will be other axes and other tangents.

the social or financial standing of Darwin[1] and Buffon,[2] as affording them freedom to write that which they conscientiously believed; who apparently denies genius to a wealthy man; who allows only religious people, or more correctly, prophets, to be genii, of whom

> "one parent at least must have spiritual visions or must be a Hebrew,"[3]

and who must be either under the influence of his mother or some other woman;[4] this man, who at last loses his temper (figuratively of course) and broadcast scatters libels against the scientific world, shouting, "The degenerate monomaniac of evolution;"[5]—this is the man—and there are, alas, many more like him—who proclaims the impossibility of scientists to do that which up to date they have not done, and declares that all that underdone by man, and yet existing, has been accomplished and brought to pass by divine agency only. Thus such men as he say they think it impossible for man to construct albumen, and dogmatically make the assertion that, even granted the construction of albumen, living albumen could not be made, for that life is a power divine and that therefore to us mortals "Life is an insoluble puzzle."[6]

Now we may or we may not be able to form living matter. Spencer, in his essay, "The Development Hypothesis,"[7] writes:—

> "In a debate of the development hypothesis, lately narrated to me by a friend, one of the disputants was described as arguing that as, in all our experience, we know no such phenomenon as transmutation of species, it is unphilosophical to assume that transmutation of species ever takes place. Had I been present, I think, passing over his assertion, which is open to criticism, I should have replied that, as in all our experience we have never known a species *created*, it was, by his own showing, unphilosophical, to assume that any species had ever been created.
>
> "Those who cavalierly reject the Theory of Evolution as not being

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[1] "Origin and Nature of Man," part iii., p. 17. McKinney tries to gloss this over on p. 21.

[2] *Ibid.*, part iii., p. 8.

[3] *Ibid.*, part iv., p. 48. On the same page, McKinney writes,—"The ancient Hebrews, whom materialists confound with Jews." What a fund of lore!

[4] "Sometimes it may be another woman than the mother who reveals Jehovah so as to make a man a genius" (part iv., p. 46). McKinney knows that women are, generally speaking, more impressional than men, and that therefore women being won over, the force of sexual attraction will do the rest. McKinney has correctly analysed church congregations—and so have I the last Alexander and Torrey mission at the Albert Hall—and found that they mostly contain young girls, married Magdalens, and old women, with just a sprinkling of the other sex. Out on such petticoat religion!

[5] "Origin and Nature of Man," part iv., p. 47.

[6] *Ibid.*, part iii., p. 11.

[7] "Essays: Scientific, Political and Speculative," vol. i., p. 1.

adequately supported by facts, seem to forget that their own theory is supported by no facts at all."

The argument which Spencer employs as regards creation is adaptable here. It is most unphilosophical to deny point blank the possibility, *i.e.* to state the impossibility for man ever to form living matter from inorganic substance, because up till now it has not been done.

But the whole question is at present an open one. It cannot be declared possible. Neither can it, on the other hand, be declared impossible. It is still *sub judice* theoretically, whether or no living matter can be produced from dead mass or other force-forms.

If man does not succeed, it will either be because the agencies once at work are now no longer in existence, or because the forces constituting life are far beyond our control; but life or the complexity of forces is natheless natural, a characteristic, if one chooses to term it so, of the whole system of forces (taken as a unity) round about us (though not everywhere in evidence), and of which we form a part, and is no more divine—though just as much so [1]—no more a wonder or a miracle—though just as much one—as any of the other forces which make up the entirety.[2]

And the actual state of our present knowledge? What do we know of albumen and of life?

Carl Oppenheimer informs us—and we know it from many another source too—that albumen can be acted on by certain agents, giving definite reactions;[3] but such reactions, although taking place in each instance in all egg-white bodies, are such that it cannot be said that everywhere where they take place, it must necessarily indicate the presence of albumen.

All albuminous bodies are soluble on being heated in phosphoric acid, and some even in water. Those soluble in water are coagulated by heat, or by the action on them of alcohol, ether, tannic acid, and many mineral acids and metal salts. They form insoluble salts with bichloride of mercury (corrosive sublimate), copper sulphate (blue

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[1] One is perfectly at liberty to give the collective name of 'Divinity' to the sum of all the force-forms of the universe, or, for that matter, to apply to them any other nomen whatsoever.

[2] If we cannot bring 'dead' matter to life, it is because the doing so would, in some wise, interfere with, clog the general mechanism and ultimately cause the cessation of motion of the universal system, *i.e.* the process would not be characteristic, for the nature of one of the characteristics of infinite force has been shown to be infinite motion.

[3] For a full account of the reactions, *vide* Beilstein's "Handbuch der Organischen Chemie," 2nd ed. vol. iii., p. 1258-1310, Hamburg and Leipzig, 1890.

vitriol), lead acetate (sugar of lead), and silver nitrate (lunar caustic), and are therefore used as an antidote for these poisons.[1]

All proteids possess a dextro-rotatory power, the specific rotatory power of the yellow line D for egg-albumen being $-33.5°$ (Hoppe-Seyler) or $-38.08°$ (Haas), whilst for serum albumen it is $-56°$. Egg albumen coagulates at 70°C.—73°C., again at 76°C. and a third time at 82°C.

This book being no chemical treatise, the foregoing has been deemed sufficient to indicate that very much is chemically known of the proteids—a complete and detailed account would take up volumes —and the hope is here expressed that more time will be given to the study of this branch of science.

It remains to be said that Dr. Leon Lilienfeld has synthetically set up a body which gives all the known chemical reactions of egg-white, but from this fact alone it were premature to call this stuff albumen, the more so as it is just possible that only a given portion of the albumen is really acted on by the reagents, so that Dr. Lilienfeld need only have produced a part of albumen—that part on which the reagents act.

Many are the bodies calling for our attention, but their study is so new that some time must necessarily elapse before certain knowledge is obtainable.

Thus the albumen 'hæmoglobin,' the colouring matter of the blood ($C_{600}H_{960}N_{154}Fe_1S_3O_{179}$), when treated with only a very slight dilution, breaks up into albumen and hæmatin. Its iron is fairly constant, 0.42 per cent. being generally present. Protogon, a substance found in the brain, containing a comparatively high percentage of phosphorus, is probably a glucoside of lecithin.[2] This nitrogenous glucoside is cerebrin (found in the nerve tissues—Halliburton). Lecithin ($C_{42}H_{84}NPO_9$), a wax-like derivative of glycerine, found in the nerve tissues and the seeds of plants, decomposes to stearic acid ($C_{17}H_{35}CO_2H$), glycerophosphoric acid and neurine $\left[C_2H_4\left\{\begin{matrix}OH \\ N(CH_3)_3\end{matrix}\right. OH\right]$, all three of which can be artificially built up, but yet, as far as I know, no one has up till now succeeded in putting these three together—probably owing to our present want of exact knowledge of the life process.

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[1] "Chambers' Encyclopædia," art. 'Albumen.'

[2] "Elementary Chemistry," p. 368, by Prof. H. Roscoe; pub. Macmillan & Co., London, 1882.

Living proteids and albuminoids differ in many ways from non-living or dead albumen.

Albumen, this amorphous jelly-like[1] mass when living, reduces silver nitrate ($AgNO_3$), which, as 'dead' crystal or powder, it does not.[2] Egg-white, non-living, does not decompose for years, but living protoplasm soon breaks up.

Although, when dead, albumen is easily coagulatable, bacilli spores, which contain it, have been known to withstand 110°C.[3] heat. On the other hand, although microbes have been shown to lose their activity, but yet to be alive and able to resume work on being carefully thawed, after being exposed to a cold of −83°C. for 100 hours, yet they die on the application of 60°—70°C.[4] The glacier flea, notwithstanding the intense cold of Swiss glacier pools, dies even in the warm palm of the hand, as I myself have seen many a time. Diatoms (*Diatomaceæ*) again, which, owing to "their minute size and resistance to drying, favour their distribution in the form of dust," are found in regions very far apart, and thriving alike in the icy waters of a mountain glacier and in hot springs. This variation of life may be due in part to the chemical nature of the original cells, which must have been very different in different places.

We must also bear in mind that Martin[5] has shown us that much depends on the temperature and pressure of the object and its surroundings. Living matter, says Martin, has a remarkably constant temperature,—

> "A temperature too high exceeding its critical temperature of decomposition and thus destroying its structure, while a temperature too low causes it to cease to decompose and the living matter becomes inactive.
>
> "*The temperature range of animal life, then, is probably nothing more nor less than the range of the critical temperatures of decomposition of a certain series of very complex carbon compounds grouped together under the name 'protoplasm.' The external pressure of the atmosphere coincides roughly with the critical pressures of decomposition.*"

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[1] Martin (*vide* p. 129) gives as a reason for this jelly-like consistency, that the general chemical affinity of carbon for hydrogen, oxygen, and nitrogen is exceedingly small. This, together with other considerations mentioned in chapter ii., pp. 120-123 of his "Researches on the Affinities of the Elements," bring him to believe that, the atomic attraction for the constituents for albumen being small, there will also be little cohesion between the molecules of a mass of this substance, *i.e.* that it must assume a liquid or semi-liquid form.

[2] "Die Chemische Kraftquelle im Lebenden Protoplasme," by O. Loew, Munich, 1882.

[3] "Chemical Physiology and Pathology," p. 167, by Prof. Halliburton.

[4] McKendrick and Coleman, Proceedings of the Royal Institute of Great Britain, 1885.

[5] *Vide* p. 129 of this work.

But it would also seem as if life itself, or rather this co-operation of physical forces which we call life, varied in its organisation; that these forces differed in their relationship to each other, and in the amount of effort they exerted, in a somewhat similar wise as do the atoms in molecules of polysomerides, *i.e.* that there existed a sort of force isomerism. Probably, the truth is that all these factors are in play.

In a living body there are, however, apparently no other forces at work than in other parts of nature, *i.e.* no so-called 'vital force': but all the physical force-forms known to us are here in interaction, and not only a few of them—but I am anticipating.

When the individuals taking part in this concert of the powers of nature are each accognised or recognised, and the functions allotted to each made clear, then will it be easier to know whether the life-process can be synthetically put to work or if the operations are on so gigantic a scale that the task is beyond the fulfilment of frail humanity.

If life can be born in the laboratory then would it support or aid in the maintenance of the life of the entire universal system, since the act were real, necessary, and had a purpose. If it be impossible, it is because the artificial generation of life is not characteristic of the universal forces, it would cause the cessation of infinite motion, which has been shown to be one of the attributes of this system.

Time alone will prove which conception is right.

But the fact seems to stand out clear that although we do not see the interior links which hold the members of this vast coalition together, we do recognise the individuals themselves, as so-called heat, chemical, electric, and other physical forces, and so on. In the case of the life of plants, at all events, there is probably also the action of sunlight.

The actions and reactions going on are partly of a destructive (katabolic) and partly of a constructive (anabolic) nature. The union of katabolism and anabolism, *i.e.* this "sum of the changes, con- and destructive, which goes on in living bodies" is metabolism.

Pflüger has shown that the living proteids contain an inorganic compound—cyanogen (CN)—which the dead ones do not, and attributes the entire metabolism of a living system to this agent; *i.e.* where cyanogen is there also is life, whilst where cyanogen is not there is death.

Not that cyanogen is a life creator or supporter, but that it is this agent which keeps the living system in a sort of unstable and labile

condition. Possibly it is an inorganic ferment like N_2O_3 in the manufacture of H_2SO_4. Cyanogen would thus work very much like the contents of an electric Leclanché battery cell. When first one puts sal ammoniac in the water of the cell, it takes some little time before the battery attains its maximum energy, and it is not advisable to use it during this time. Even after the bells have been continually ringing for a long duration, the Leclanché feels exhausted and has to take a rest, or gets out of order. So, too, with cyanogen. It stirs up the living forces to a certain degree, and then its power runs down. After a pause, it starts afresh, and so up and down runs the potential energy of the system.

Does this in part account for our waking and sleeping, independently of fatigue and of the anabolic action of sunlight being removed at night? Is it thus, that at times of cyanogenic high potentiality, sudden misfortune can by a weak man be bravely borne, whilst at low potential, the strongest man—being at the moment of low vitality—is so unresisting, that the slightest attack from without so staggers, so depresses him, that he only arduously withstands the tendency to utter collapse? These are only humble suggestions on my part, and such psychological side issues must not detain us.

Professor Halliburton mentions, that according to the opinion of O. Loew, formic acid (CH_2O_2), on being treated with ammonia (NH_3) produces aspartic aldehyde. By polymerisation one obtains $C_{12}H_{17}N_3O_4$ and by further polymerisation in the presence of a compound of sulphur and hydrogen, we get $6C_{12}H_{17}N_3O_4 + H_2S + 6H_2$ giving us $C_{72}H_{112}N_{18}SO_{22}$, the formula for albumen. The difficulty here is that the aldehyde of aspartic acid is not known. Every probability, however, is that it exists, but is so unstable that it is not procurable, or at least only after a great amount of trouble. Yet even this granted, Loew's hypothesis is still doubtful. Pflüger thinks that the nitrogen of the non-living proteid leaves amidogen (NH_2) to form cyanogen. But Latham's view, says Halliburton, may probably be deemed correct, which reconciles or rather combines the ideas of Loew and Pflüger. According to Latham, a proteid is nothing but a chain of cyanalcohol to which is bound a benzine nucleus. Cyanalcohol is the aldehyde *plus* hydrocyanic acid.

The smallest particle of living proteid (protoplasm) is the cell, and yet Nageli gives the amount of albumen or egg-white in a monad, or simplest living unicellular protoplasmic mass of 0.6mm. diameter, at over five billion molecules. This, personally, I consider greatly under-estimated, for probably, although as we saw on

pp. 128-133, the molecule of albumen is a large one, yet guiding myself by the approximation of p. 128 and p. 133, there are nearer twenty-one million billions in a sphere of 0.6mm.

The constituents of this cell most likely came together in a wise analogous to the formation of crystals, only in a jelly-like condition. When a liquid crystallises out, either one or several centres are soon formed from which the crystals radiate. The centre is the densest and, more often than not, contains less water of crystallisation, due in part to internal pressure. This or these centres are represented, in the protoplasmic cell, by the nucleus or nuclei: alth ugh, on the authority of Ray Lankester, "Working with full command of the most modern histological methods," the $\frac{1}{2000}$ inch in diameter Archerina is actually non-nucleate. So too, according to Gruber, is the *protamœba vorox* as also, if we are to believe Haeckel, the *Myœastrum radians*.

In collecting the particles, heat also may have played a part.

Owing therefore, on the one hand, to the fragile nature of the structure, easily able to change the position of its atoms—thus easily formable to isomerides—and on the other, to pressure, warmth, friction (this latter causing electric action) and other agencies, these nuclei became isomerides (polysomerides or with greater presumption, alloisomerides) of the original body, *i.e.* became differently constituted substances; *i.e.* there came into existence various living albumens, later on distinguishable as animal and vegetable protoplasm.

The protoplasmic nucleus was first discovered by Robert Brown in 1821 in pus-corpuscles, and in animal cells about twenty years later by Theodor Schwann.

Heat and light set the outer fluid or cell sap in rotation or circulation, and this rotative power of light is well known experimentally to all physicists. Either this sap-rotation, or the result of the collection of solid particles towards a centre in a liquid medium, may have caused a rotation of the entire, when centrifugal force would carry the heavier particles to the exterior again, making the exterior a denser mass than the interior. The exterior can have cooled down, whilst the interior remained warm—the warmth due to friction and chemical action.

At all events, the fact remains that the exterior is a denser mass than the interior, and for reference are termed respectively ectosarc and endosarc. This ectosarc probably collected foreign matters on its outer surface; sometimes sand, sometimes a shell of lime, or it

was chitinoid, or siliceous. *Astrorhiza* has a coating formed of particles of sand. *Haliphysema* has a shell formed of detached sponge spicules. The shells of Foraminifera are most likely formed after the principle of the compartments of slate-chalk (German, Dachstein-Kalk) crystal formations, a piece of which, from Boggenhausen, I have now before me. There are organisms that have a shell varying according to the medium in which they are found. Thus *Miliolina* (a family of the class foraminifera)[1] have a shell which is at times chitinoid, or of lime, here and there siliceous mixed with much chalk when they are on the ocean surface, whilst at depths of 2-3,000 fathoms there is a preponderance of silicium over the calcium. On the other hand, most birds, when they are removed to sites on which the usual materials for the formation of the shell are wanting, lay eggs which have no shell at all.

The chitin [$C_{15}H_{26}N_2O_{10}$ (according to Ledderhose) or $C_{60}H_{100}N_8O_{38} + nH_2O$ [2] (according to Sundwik)], has been shown by Prof. Huxley, at least as regards the crayfish, to be formed as a modification[3] of the superficial portion of the cells; whilst, "in some cases, the epidermic cells probably sweat it off after the manner of other secretions." In acorn-shells (*Balanus*) too, the shell is the probable result of combined slow in- and external chemical reactions, and so also in very many other shell formations.

As chitin, when heated with concentrated mineral acids, gives us glucosamine and acetic acid, *vice versâ*, *i.e.* the making of chitin from these two should be possible.

The first movements of the cell were amœboid; that is to say, as soon as the jelly-like protoplasmic mass was formed, it moved like an amœba, a unit mass of living matter of an animal nature, the motions of which were first studied by Rösel von Rosenhof in 1755.

Actually, the very first form, the protoamœba had no nucleus; but this can be likened by analogy with the crystallising liquid just a few moments before the centre densifies, and therefore the protoamœba can be best described as virtually being but a stage in the life-history of the amœba, just as later on the hydra is a stage in the life-history of the medusa.

The nucleus of the amœba is more refractive than the rest of these unicellular beings (protozoa), and may therefore in part be responsible for their movements.

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[1] Foraminifera are in the Rhizopod division of the subkingdom protozoa.

[2] This latter is therefore approximately four times the formula of Ledderhose + water of crystallisation, which is probably more correct.

[3] Due most likely in part to environmental influence.

"The naked mass of living matter or protoplasm flows out in all directions in blunt processes (*pseudopodia* = 'false feet') . . . . The amœba flows along the surface of stone or plant by the slow protrusion of the ever-changing processes. In this way, too, it flows over and gets outside particles of food, such as diatoms, which are engulfed in the protoplasm, and form with the little bubble of water surrounding them what are known as food vacuoles."[1]

From this we see that the first actions are of a purely mechanical nature—even the assimilation of food being a purely chemical and mechanical process.

While the amœba is continually flowing into new shapes, the foraminifera only protrude their processes (*pseudopodia*) through openings in covers of sand, carbonate of lime, and so on.

Owing to the position of the nucleus or nuclei and the vacuoles (bubbles with a fluid in them), the motion would in time evolve in certain directions about these, thus originating muscle. These amœba have in their medium few materials to assimilate which, later on, could produce reactions causing their decomposition or death,[2] and are thus far in advance of the human[3] white or colourless blood-corpuscles [vegetable (fungus) matter], the phagocytes or leucocytes, which absorb both nutritive and harmful particles.

The fact that all the early cells contained albumen, is no proof that they could in themselves re-produce albuminous matter, although they might be able to increase in bulk by the absorption of more such ready-made material. It is conceivable and probable that other unicellular bodies existed of similar formation, but of other constituency, having chemical affinity to those ingredients of the surrounding medium which, together with its own matters, were constructable to proteid stuffs, including the albumina and albuminoids.

Thus it is not necessary to assume, as most have done, that because the animal kingdom now obtains its albumen from the vegetable kingdom, that animal life has evolved of plant life. There are even animal unicellular individuals that assimilate only inorganic matter, as in the case of Myxoplasmodia, to which granules of calcium carbonate ($CaCo_3$) adhere and are gradually absorbed.

Rather let us accept the idea that plant and animal life in the

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[1] *Vide* "Chambers' Encyclopædia," art. 'Amœba.'

[2] Of course poisons could be administered. Amœban death is due in most instances to physical change.

[3] I mean here, of course, in the human body. They are an independent colony of cells, and have no organs of any kind.

shape of the little nomad or one-celled body, formed and evolved side by side with each other in a common fluid, and then later, through other influences, such as that the motile algæ enter encysted animal cells and *vice versâ* and so on, attained the inter-relationship at present prevailing—the plants forming that which the animals assimilate, decomposing to (exhaling) that which animals require to their composition (inhaling), and that plant material has chemical affinity for the components of the colouring matter chlorophyll "by the aid of which the carbonic anhydride is absorbed and split up in sunlight," whilst animals "are only able to use food products which have already been lifted up to a comparatively high level, which have in fact been worked up by plants or other animals into complex compounds,"[1] such as albumen, fats, starch, sugar. Both plants and animals assimilate a small quantity of iron, phosphorus, sulphur, and calcium, but in very different proportions.

The lovely crystals of snow-flakes are well known. Imagine that crystals of such or similar forms grew, after formation, as does the smoke-topaz or mountain crystal. Suppose further, that when such a crystal grew to a certain length it broke, that by the heat of breaking a liquid forms which crystallises again on cooling. We should then have a condition very similar to that obtaining in the prime cell, only that it is interior intermolecular action which breaks it up, and that its substance is jelly-like, so that one part runs into the other when dividing and the point of division is lost sight of.

The simplest way is by breaking up into two parts, in which case each half is called a sister cell and forms anew, after the manner of the prime cell. The procedure is 'fission' or dividing. This fission is actually the same as 'budding' as seen in the algæ *nostoc*, *oscillaria*, *rivularia*, etc., with the sole difference that in this latter case the expulsion of the one half by the other was not so forcible, and therefore failed to separate the two.

Both in budding and in fission, the sister cells grow in bulk by assimilation to a certain size, and to that size only. Herein, too, they differ from crystals, which apparently go on growing indefinitely, but this deviation as well is only mechanical. When their mass becomes partially saturated, *i.e.* can take up no more foreign matter to cause growth, it can still absorb such matter as will renew those parts decomposed by oxygen and by so-called organic[2] reagents,

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[1] Organic bodies are, as we have seen, nothing more than inorganic compounds in which carbon and hydrogen are the only or chief constituents.

[2] *Vide* footnote [1].

forming as by-products during the process of assimilation. Such reactions are 'renovation.'

Renovation is, however, to be found in inorganic chemistry, as instanced in the manufacture of sulphuric acid (H_2SO_4). If sulphurous anhydride (SO_2) be brought together with oxygen (O) and water (H_2O), the process can be expressed by the chemical equation $2SO_2 + O_2 + 2H_2O = 2H_2SO_4$. But this reaction is accelerated by the presence of nitrous acid (N_2O_3). What takes place is given by the equation $H_2SO_3 + N_2O_3 = H_2SO_4 + N_2O_2$. The nitric oxide ($N_2O_2$) joins the oxygen of the air to form N_2O_3 and on it goes again. Thus nitrous acid (N_2O_3) is broken up, but that part which it lost—the one atom of oxygen—it takes back from the air. Thus does N_2O_3 renovate itself at the expense of the surrounding medium—air.

Similar processes take place ~~to~~ in the human body, as when oxyhæmoglobin forms to hæmoglobin and again to oxyhæmoglobin.

Budding and fission are the earliest forms of so-called reproduction. The part or parts which break off are less saturated than the main body, so that they can go on growing and existing after the original body has died (is dead). But it must be clearly understood—and the majority of people (though not all) do not seem to have done so—that the reproduction of animal matter is not different from that of inorganic matter, for it is no more a *perpetuum mobile* than any other motion, such as the inorganic budding of hydrous oxide of manganese to form the dendrites[1] which one finds lining the joints and fissures of rocks or eozoön formations, and ceases at once when the supply of suitable matter (nutriment) is exhausted. If air with its oxygen were not present, nitric oxide could not become nitrous acid, nor hæmoglobin become oxyhæmoglobin. It is therefore a mistake to use the expression 'reproduction' as if it expressed some occult power on the part of a so-called living substance to produce its similitude out of nothing. I emphasise this fact, that reproduction is just an ordinary chemical process (aided by physical agency) the same as any other, in which the substance will in part absorb (mechanical mixture) and in part form chemical compounds out of the matters in the surrounding medium *so long as their supply lasts and the physical conditions remain approximately constant*, but these com-

[1] Formerly mistaken for fossils of algæ.

pounds are naturally always the same[1]—are reproductions. When the reproductions break, or parts are thrown off to form individual bodies, there is an instance of multiplication. The question of the preservation of type is one of heredity, and the laws of heredity require an exact study of their own, but a somewhat fuller explanation will be found in this chapter in the special section treating of 'Reproduction.'

We are, however, hastening too far ahead, and are neglecting to take in all our bearings.

Next to the breaking into two parts comes the more advanced stage of dividing into many portions, which action, like crystallisation, takes place symmetrically, as one sees in the life history of the algæ *chlamydomonas*, *pandorina*, and the like. The most beautiful snowflake-like structures, but far surpassing these in their nigh dazzlingly complicated, yet perfectly harmonious and symmetrical structures, are to be found among the radiolaria, and, later still, in the fundamental frames of the medusæ.

The action of division ('fission') is generally a very rapid one. In the very primitive protococcus (a unicellular plant),—

> "multiplication by transverse division is in active progress; twos and fours are thus formed, but soon separate as independent cells. . . . Especially after a period of cold or drought, the remarkable process of 'rejuvenescence' may be observed: the protoplasm escapes through a rupture in the cell-wall, develops a couple of delicate contractile filaments or cilia, and thus enters an actively 'motile stage' of existence. After a time the resting phase is resumed, the cilia being withdrawn, and the cell-wall redeveloped."[2]

This rupture is also mechanical, for the wall was thin, and burst as soon as the interior matter swelled (grew) too much. Then, most likely, environment did its work, and the formation of cilia or hairs becomes nothing more than a physico-chemical action due to the behaviour of the medium. Cilia might, in all likelihood, be formed in a comparatively thin medium by sudden electric discharge, and certain it is, that cilia are formed not at the point of rupture with the older cell, but outwards.

This cilium is that which causes the "mechanical rhythmic wave or screw-like" motion of the spermatozoon or male cell in animals, and is found also in other parts of the body, such as those

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[1] The constituent bodies not having altered their chemical affinity nor their nature—at least not sufficiently to alter the reaction, the changes in them going on at a very much slower rate.

[2] "Chambers' Encyclopædia," art. 'Algæ,' by Patrick Geddes, F.R.S.E.

"welche die Oberfläche der die innere Auskleidung des Eileiters bildenden Schleimhaut bedecken,"[1]	"which cover the surface of the mucous membrane that forms the inner lining of the ovary duct,"

in females and so on. In certain primitive beings, *e.g.* the Titolotus, and so on, we find long cilia on the kidneys joining to long jelly masses which lie in the interior on each side of the body and which may be regarded as the origin of fins, and, later on, of legs and arms. According to Rolleston[2] there are motile cilia in the vestibule of the ear of the lamprey.

What environment can do we see in the case of the alga *Botrydium*, where

> "multiplication may take place by simple lateral gemmation, or by other methods, varying widely with the conditions of the environment. In ordinary circumstances, when moisture is abundant, the protoplasmic contents simply break up into zoospores, which, on settling down with or without conjugation reproduce the plant. Under the influence of drought and sun, the protoplasm descends into the root filaments, and there encysts itself, rejuvenescence by-and-by taking place as usual; while, on the approach of winter, the encystment takes place with the upper vegetated portion of the cell, which becomes gradually thickened."[3]

Still more to the point is the structural change which has been experimentally demonstrated by Schmankewitsch to take place in the half-inch long brine-shrimp (*Artemia*), where, solely by increasing the salinity of the water medium, the highly ciliated species *Artemia Salina* gradually loses the feathered cilia of its tail, and the cilia ~~become devoid of their feathering, and~~ decrease in number till, after going through the phases of all five species of the genus, the species of *Artemia milhausenii* is obtained, perfectly devoid of cilia. *Vice versâ*, by decreasing the salinity, *Artemia salina* can be sufficiently modified to receive many of the characteristics of the widely different fresh-water genus, Branchipus. It is very easily conceivable that this saline increase and decrease can easily be brought about by simple physical and chemical changes without any special intervention whatsoever.

It may, *en passant*, be noticed that fine hairs are also found in inorganic nature, as in some examples of Gibson or silk-spar, and

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[1] "Licht und Leben," by Prof. Dr. Ludwig Büchner, p. 253; pub. Theodor Thomas, Leipzig.

[2] *Vide* "Forms of Animal Life," by Prof. G. Rolleston.

[3] "Chambers' Encyclopædia," art. 'Algæ.'

pre-eminently in the fibrous, silky, soft, and even slightly elastic asbestos (Mgo, Sio_2 lime and oxide of iron). Were this asbestos but more elastic and gelatinous, it would be yet more analogous to the cilia or hairs of young algæ and protozoa.

Fission is still found even at a somewhat higher stage of development, for the marine worm *Myriamida* multiplies in this wise, the young worms being the cast-off extremities of the older. In an adult, worms of various sizes are seen—the smallest at the tail end.[1]

The minute bacteria, of which one of the first observers was Leeuwenhoek in the 17th century,

> "usually appear as minute spheres, rods, or threads, propelled along by delicate lashes, or quivering together with the usual tremulousness of very small floating particles, or lying more passively entangled in a jelly-like flake. In a short time it will be seen that these bacteria multiply with extraordinary rapidity by cross division; one soon becomes a thousand, and the minute specks which appear may, if the water contains enough[2] food, soon form a mass filling the vessel."[3]

But these bacteria are, as most savants at the present time acknowledge, no more animals than are the algæ—animals having been found to have "no monopoly of mobility"[4] and,

> "it is now a commonplace observation that the simplest plants exhibit a power of locomotion which is almost wholly lost in the higher forms."[5]

Certain algæ and some liverworts, and also the little monocotyledon duckweed (Lemma) float freely in the waters without ever permanently taking root. On the other hand there are advanced organisms, which although as larva free-swimming, attach themselves to the ground or rocks when matured; a change which is to be seen from the tadpole-like larva to the adult ascidian. This latter must however be, I believe, considered as an instance of degeneration (devolution), whilst the evolution of a root is more evinced in the life-history of the alga *Botrydium*.

These bacteria or schizomycedes were shown to be vegetable matter by Cohn in 1853, and to be fungi by Nägeli in 1857. So much so, are fungi and algæ alike, that actually we arrive at the

> "fungal form from the corresponding algal one, by the simple disappearance of its chlorophyll, consequent on the assumption of

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[1] *Vide* Hatschek's "Lehrbuch der Zoologie."

[2] The degree of multiplication of bacteria is dependent on the amount of suitable food found in the watery medium. Here too, reproduction is dependent on the outer supply.

[3] "Chambers' Encyclopædia," art. 'Bacteria,' by J. Arthur Thomson.

[4] *Ibid.* [5] *Ibid.*

parasitic or saprophytic life, just as it is observed among phanerogams, such as dodder or toothwort. The presence or absence of chlorophyll becomes thus the only absolutely constant distinction between fungi and the algæ."[1]

The change may be solely due to environmental influence.

Between Fungi and Algæ are the Lichens, or rather, a lichen is a colony of two families, each having thousands of members. De Bary in 1866 was the first to notice that these two families were Algæ and Fungi living side by side. Thus in the lichen *Collema pulposum* fungi form the threads, whilst the globules are algæ.

"Most of the lichen-forming fungi are *Discomycetes* or *Pyrenomycetes;* the associated algæ are very varied—*e.g. Palmellaceæ*, *Choolepideæ*, *Nostocaceæ*, *Confervaceæ*, etc."[2]

Not only are there unions between algoid and fungoid elements, but such a symbiotic relationship exists between algoid and animal individuals, as in the case of unicellular algæ and radiolarians, a relativity attention to which was called by Geddes and Brandt.

These algæ, which are of the genus *Zooxanthella*, *Philozoon*, or the swarm spores of various other olive-green seaweeds, live and multiply after the death of their host, and conjugate like free algæ. They live on CO_2 and nitrogen waste, evolve oxygen in the sunlight,[3] and form starch which the radiolarians absorb. Nay more, when the algæ die, they are digested by their partners, *i.e.* the radiolarians live in part on themselves, for these algæ are part and parcel of themselves, as they are in the lichens.

"Similar symbiotic Algæ occur in some Foraminifers, in several Cœlenterates, especially otherwise colourless sea-anemones, and according to Geddes, in some species of Turbellarian convoluta."

In the tissues of certain animals, the green colouring is owing to the direct presence of the algæ *Hydra viridis* and *Paramœcium viride*. The Infusoria (protozoa) *Stentor polymorphus*, *Coleps viridis*, *Ophridium viride*, *Vorticella chlorostigma*, are green varieties of *Stentor Mülleri*, *Coleps hirtus*, *Ophridium versatile*, and *Vorticella campanula* respectively, but their chlorophyll corpuscles

"multiply outside the body of their host after its destruction and appear to belong to different genera of unicellular algæ (*Palmella*, *Tetraspora*, *Glæocystis*, etc.). On the other hand 'the colourless part'

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[1] "Chambers' Encyclopædia," art. 'Algæ.'

[2] *Ibid.*, art. 'Lichens.'

[3] *Vide* Geddes, in "Nature," xxv., 1882; Brandt, "Archiv f. Anatomie u. Physiologie," 1882, and "Mittheilungen Stat. Neapel," iv., 1883.

of spongilla turns green on treatment with sulphuric acid, as does the colourless plant Neottia."[1]

It is also often green in full light, though colourless in the shade. As it is known that spongilla, like the common hydra, seeks the shade at breeding time, this seems to point to its requiring more oxygen at this period of its existence. The corpuscles multiply by fission as in plants. The protozoon Volvocina, again, is a green-coloured animal which is nourished like a plant, so that this distinction of the possession or non-possession of chlorophyll, as of the method of reproduction (multiplication) and of the nature of food taken, fall away between fungi and animals. Even the endoderm or inner ciliated layer of cells of the hydra often actually contain granules of green chlorophyll: whilst its growing ovum (an ectoderm cell) which feeds on the decomposition products of the outer cells, also produces chlorophyll corpuscles.

"And it may be noted that these bodies (the chlorophyll corpuscles) have colourless predecessors."[2]

Bacteria do not, like *Zooxanthella*, etc., assimilate carbonic anhydride,—

"they cannot utilise carbon at the low level of carbonic acid gas,"[3]

but

"feed on the products of decomposition of plants and animals";

for they, like other fungi, have no chlorophyll.

The vegetable (fungoid) bacteria either remain single or "united in loose colonies." In a few protozoa or unicellular animals—as contrasted with the metazoa or multicellular animals—the results of division also remain associated together, forming a loose colony by

"the thickening and gelatinisation of the individual membranes. . . . The same habit of aggregation is not uncommonly exhibited by simple unicellular organisms and also by the cells of higher animals, though in these cases the individual undits fuse more or less completely to form a composite mass or plasmodium."[4]

This building up of colonies is the origin of the plant or animal body.

"The loose colony may be very unstable, and may soon resolve itself into its component units, exactly as the primitive male cell which has divided into a clump of spermatozoa breaks up and sets

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[1] "Text Book of Zoology," vol. i., p. 243, by Parker and Haswell; pub. 1897, Macmillan & Co., London.

[2] "Forms of Animal Life," by Prof. George Rolleston, p. 327; pub. Oxford, 1888, Clarendon Press.

[3] "Chambers' Encyclopædia," art. 'Bacteria.'

[4] *Ibid.*

these active units free. But the colony may be more stable and retain its continuity (like a segmented ovum), thus bridging the gulf between unicellular and multicellular organisms. In such cases certain cells are set apart as reproductive, and eventually set adrift to start a fresh colony. This is the beginning of the differentiation of special reproductive cells. At first these were probably all alike and able to develop for themselves, but in a manner which does not concern us here,[1] they become differentiated as male or female elements, mutually dependent and complementary."[2]

In many algæ

"the dwarfed male filaments grow on the larger female ones; spermatozoid and ovum respectively develop with separation of portions recalling the sperm cap and polar vesicle of animals, or the distinction of vegetative and reproductive nucleus demonstrated by Strasburger in the pollen grain."[3]

Hydra viridis has 8-9 testes (male organs) formed

"by the local multiplication of interstitial ectoderm cells which are developed into spermatozoa and raise the covering cells into a pointed capsule. This capsule dehisces at its apex, setting free its contents into the water."[4]

"The ovum is produced by the growth of one out of a mass of cells produced by the division of interstitial ectoderm cells."[5]

We see that between algæ, fungi, protozoa and even metazoa there are no hard and fast lines of demarcation, and imperceptibly the vegetable and animal kingdom interchange those properties which were once thought to be distinctive features of the two. We see that the environment can make fungi out of algæ.

We see that bacteria can be either non-oxygen feeders or anaëroboic (like plants) or oxygen feeders, aëroboic (like animals), and we have the anaëroboic animal volocina (p. 154). Most fermentative organisms (enzymes) are capable of assuming the two conditions.

We see, too, how easily one form can fertilise another.

What chances have we here for a vast differentiation of species! This gives us some idea of how evolution or development from one class to another could take place. When we know that change

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[1] For complete information on separate male and female organisms, the reader cannot be better advised than to refer to the work "The Evolution of Sex" by Prof. Patrick Geddes and J. Arthur Thomson; which if not exact in every detail, is a fair general exposition of the subject of which it treats. Pub. by Walter Scott, London, 1889.

[2] J. Arthur Thomson, in "Chambers' Encyclopædia," art. 'Embryology.'

[3] Prof. Patrick Geddes, in "Chambers' Encyclopædia," art. 'Algæ.' *Vide* also his work, "The Evolution of Sex," as per note[1].

[4] "Forms of Animal Life," by Prof. G. Rolleston, p. 327.

[5] *Ibid.*

actually does take place in one and the same individual the matter is settled. Bacteria may be divided into—(*a*) micrococcus or globular forms, (*β*) bacillus or rod-like, (*γ*) filamentous, and Cladothrix can occasionally assume all three formations.

The life histories, too, of the primitive algæ and the protozoon are at the outset very similar, so similar in fact that the respective chemical agencies and reactions must be very allied. The separate ciliated parts of the original cell of the protozoon swim about actively, yet driven by physical forces. This

> "small active cell unites with a larger and more passive neighbour, and here we find the first hint of the profound difference between the two sexes—a difference of which a contrast between spermatozoon and ovum is literally a concentrated expression."[1]

Professor Büchner tells us[2] that the spermatozoon, seed thread or male cell, was discovered long before the ovum, egg, or female cell, namely in 1677, by the German student Ham, in Leyden. This he showed his teacher, the Dutch physicist A. Leeuwenhoek, who then gave his researches thereon to the world.

This male sperm cell of animals is not itself an animal; it does not live as animals do. It is in part a chemical compound, and in part a mechanical mixture, which, including the cilium, is about 0.01 millimetre long, the broad nucleated head having a length of approximately 0.002—0.0016mm.

> "Bei Vögeln und Amphibien sind sie bedeutend grösser, namentlich bei den Singvögeln, und nehmen bei den meisten Vögeln und vielen Fischen eine pfropfenzieherartige Gestalt an. Am grössten findet man sie bei Molchen und Tritonen oder bei Thieren, welche sich auch durch die Grösse ihrer Blutkörperchen auszeichnen; sie sind überdem hier mit einem durchscheinenden, im Wasser undulirenden Saum versehen. Dagegen ist die allgemeine Form oder Gestalt der Samenfäden durch die ganze Thierwelt sehr ähnlich

> "These are much larger in amphibians and birds, especially in singing birds, and have in most birds and many fishes a corkscrew shape. They are found the largest in the salamanders and Tritons, or in animals that are distinguished by the large size of their blood corpuscles; they are besides provided with a translucent in water undulatory fringe. But the general form or shape of the seed threads is very similar or corresponding throughout the animal world; the seed threads of the saurians and, in extension of the vertebrata especially

[1] J. Arthur Thompson, in Chambers' "Encyclopædia," art. 'Embryology.'

[2] "Licht und Leben," by Prof. Ludwig Büchner; pub. Leipzig, Verlag of Theod. Thomas.

oder übereinstimmend, namentlich sind die Samenfäden der Säugethiere und in weiterer Linie der Wirbelthiere fast ganz gleich denjenigen des Menschen oder stecknadelförmig."[1]

resembling in high degree those of man or of the shape of a pin."

But just as chemical compounds all crystallise differently,[2] although many may be like each other in most respects, so also a great similitude of spermatozoa is only an apparent one and there are variously great or small shades of variation in size, shape and character in each class or species of animals.

"Ja man muss annehmen, das diesses nicht bloss bei jeder Thierart, sondern bei jedem einzelnen Individium der Fall ist, wenn auch hier die Abweichungen oder Nüancirungen so geringer oder verborgener Art sind, dass wir sie mit unsern Hülfsmitteln nicht wahrzunehmen oder nachzuweisen vermögen."[3]

"Ziemlich abweichende und auffallende Formen zeigen die wirbellosen Thiere obwohl auch hier im Wesentlichen immer derselbe, faden-oder stecknadelförmige Typus mit verdicktem Vorderende zu Grunde liegt. Sogar Schwämme und Polypen haben Samenfäden, welche denen des Menschen und der Säugethiere ähnlich sind. Uebrigens haben *alle* Thiere Samenfäden; und einen Samen *ohne* dergleichen Formelemente kennen wir bis jetzt nicht. Sogar bei den Infusorien will man dieselben nachgewiesen haben. Auch die niedere Pflanzenwelt besitzt Samenfäden, welche nicht allein in ihrem Bau und sonstigen

"Yes, we must take it for granted that this is not merely the case with each individual species but with each single individual, although here the deviations or modifications are of so slight or hidden a kind that we are unable with our helping appliances to observe or to demonstrate them."

"The invertebrata exhibit rather aberrant and conspicuous forms, although even here the basis is in general always the same; a thread or pin-shaped type with a thickened frontal extremity. Even sponges and polypi have seed threads, which are similar to those of human beings and saurians. Moreover, *all* animals have seed threads; and a seed (semen) *without* such a distinctive element is up to the present unknown to us. One will even have demonstrated their presence in the infusoria. Even the lower vegetable world possesses seed threads, which not only exactly correspond to those of animals as regards their build

[1] "Licht und Leben," p. 259, by Prof. Büchner.

[2] Differing often in such slight things only as polarisation of light, rotary power refractivity and so on, although their shape and colour may be the same.

[3] "Licht und Leben," p. 259, by Prof. Büchner.

Verhalten den thierischen vollkommen entsprechen, sondern auch in Bezug auf ihre Entstehungsweise die wunderbarste Uebereinstimmung mit letzteren zeigen. Sie dringen auch, gradeso wie die thierischen Samenelemente, in die weibliche Pflanzenkeimzelle ein, um sich mit derselben zu vereinigen. Die Abbildungen welche Prof. Hanstein (Das Protoplasma, 1880) von einigen Spermatozoïden niederen Pflanzen (Farn, Moos, Tang, Conserve) gibt, zeigen in ihrer aüsseren Form die auffallendste Aehnlichkeit mit thierischen Samenfäden."[1]

and general behaviour, but also evince the most astounding coincidings in respect of their genesis. They, just like the animal sperm elements, force their passage into the female plant germ cell, in order there to unite with it. The illustrations which Prof. Handstein (Das Protoplasma, 1880) gives of some of the spermatozoids of lower plants (ferns, mosses, seaweeds, conserves) exhibit in their outer form the most striking likeness to animal semen threads."

It originates in man and in the most developed animals, birds, and many fishes, in the cells of the tubules of the testis, and lives in a viscid fluid which is a mixture of the secretion of the testis with that of the prostate. Mieschner's analysis[2] of the substance of the spermatozoon is the acknowledged best. According to him, it is chiefly nuclein which acts as a coating to the proteid matter of the head. Of this substance, nuclein, there are many varieties, differing in constitution according to environment. The representative formula may be given as $C_{29}H_{49}N_9P_3O_{22}$. Although sulphur and iron are in some nucleins, there are none in that of the spermatozoon, the chemical bodies of which it is formed, being

(1) nucleïn ($C_{29}H_{49}N_9P_3O_{22}$)[3] in combination with a base,
(2) Protamine ($C_{16}H_{32}N_9O_2$),[4]
(3) proteids,
(4) another substance akin to a proteid, containing 4 per cent. of sulphur, and a few other matters from the testis,
(5) lecithin[5] ($C_4.H_{84}NPO_9$),
(6) cholesterin ($C_{26}HO_{44}Aq.$),[6]

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[1] "Licht und Leben," p. 260, by Prof. Büchner.

[2] "Verhandlungen der Naturforscher Gesellschaft in Basel," vi. 138.

[3] Picard, "Berichte der deutschen Chemischen Gesellschaft," vii. 1714.

[4] Diaconow, "Hoppe-Seyler's Med. Chem. Untersuchungen," ii. 221, iii. 405.

[5] The nuclein of bull-semen, as seen above, differs from that taken from pus corpuscles, which contain sulphur.

[6] This formula, first given by Chevreul, is that now generally adopted, although $C_{26}H_{43}HOAq.$, or even $C_{25}H_{42}OAq.$ and $C_{27}H_{46}OAq.$ have been given, the latter two being improbable.

(7) fat: tristearin $[C_3H_5(O{\cdot}C_{18}H_{35}O)_3]$ and tripalmitin, $[C_3H_5(O{\cdot}C_{16}H_{31}O)_3]$ held in solution at body temperature by trioleïn $[C_3H_5(O{\cdot}C_{18}H_{33}O)_3]$

According to Mieschner, the above substances are present in the spermatozoon of the salmon in the following proportions:—

Nuclein	48.68 per cent.
Protamine	26.76 ,,
Proteids	10.32 ,,
Lecithin	7.47 ,,
Cholesterin	2.24 ,,
Fat	4.53 ,,

This result is of course not quite as exact as it looks, for it is not proved beyond doubt that protamine is always present, although it is there in the month of November. If, however, its temporary presence be proved, this may be due, (*a*) to environment—the neighbourhood where salmon lay their spawn being shallow (more earthy) and with beds of fine gravel—and (*β*) to physico-chemical in- and exterior re-actions, due, on the one hand, to the physical condition of the male,[1] who is prepared to pour its milt on the deposited spawn, and on the other, to the climatical changes which the end of autumn brings with it. More exact information is here desirable, for the time of spawning is different in different rivers, dependent probably in great degree on latitude, altitude, and temperature generally.

Then again, no margin has been left for small amounts of other matters arising in the testis, whilst in the nuclei is also to be found slight quantities of plastin and adenin $(C_5H_5N_5)3Aq$.

Of all these substances of which the spermatozoon is made, we can make some artificially, some in part, whilst the exact chemical nature of all is known, with the exception of the proteids, inclusive of albumen and plastin, although even the former of these two last is approximated.

Our exact knowledge seems to be that:—

(1) nucleïn is metaphosphoric acid + albumen, of which metaphosphoric acid can be artificially built up of the elements, and then with the addition of albumen, synthetically forms nucleïn,

(2) adenin is obtainable among other products by boiling nucleïn

[1] That physical changes are going on in no small degree is evidenced by the bright hue changing to a dusky tone tinged with red, and by the actual change in the shape of the snout.

with dilute sulphuric acid. It is a decomposition product of all animal and vegetable cells, but there is no certainty that it exists independently in the live protoplasm.

(3) **protamine.** Nature of consistency known. Not yet artificially procurable.

(4) **proteids.** Only the approximate consistency known.[1]

(5) **lecithin.** Its decomposition products are known, each of which can be synthetically built up, but the union of these as lecithin not yet obtainable. (*Vide* p. 141.)

(6) **fats.** These and their solvent known, and they can be artificially made.

(7) **Cholesterin** is known to be a monatomic alcohol, its exact chemical formula having been fixed. It is obtainable from the greases of sheep's wool. After cholesterin has been extracted, the residue is lanolin. For the above reasons, the synthetical construction may be expected in the near future. On the other hand, to be impartial, it is thought by some to be but a decomposition product of albuminous compounds in the life process of the cells.[2]

(8) plastin—cytoplastin or the plastin of cytoplasm,[3] as distinguishable from chloroplastin or the plastin in chlorophyll, is a nucleo-albumen, and therefore its synthesis possible as soon as we have that of albumen.

There is also a mucin-like substance—spermatin—and mucin is a proteid + a carbohydrate ($C_6H_{10}O_5$).

Of the above components, protoplasm contains only 15-20 % as solids, whilst the rest of 80-85 % is water. The prostatic secretion has 98.5 % water, 0.45-0.92 % proteids and 1 % salts, of which latter the most is common salt (sodium chloride, NaCl), and then come potassium salts—sulphates, phosphates—especially calcium phosphate. The sodium chloride swells the nuclein to a jelly.

When human semen evaporates, the crystal phosphate of a base C_2H_5N is formed, which has been given the name 'spermine.' This is, however, probably another term for ethylenimine which can be prepared artificially from ethylenediamine hydrochloride (Ladenburg and Abel).

The spermatozoon—this tiny flagellate monad that moves by

[1] The reader is here referred to all that has already been said on this subject in this chapter.

[2] Hoppe-Seyler, "Handbuch der physiologischen und pathologischen chemischen Analyse," 4te Auflage, p. 110.

[3] The protoplasm of cells as distinguishable from protoplasm elsewhere.

simple endosmotic action, like an eel straight ahead, at the rate of 0.04 mm. per second, and which is made up as above—has its origin in the ordinary cell. I may here add, that the motion of the cilia of the human body

"so mechanisch ist, dass sie noch viele Tage nach dem Tode fortzudauern vermag." [1]	"is so mechanical that it can continue for several days after death."

An ordinary sperm cell, at first amœboid, and then round, breaks up into a ball of ciliated spermatozoa, which separate and live independently, till they meet other cells which are dividing to give rise to the sperms. These they enter, the cells being soft and receptive to the slightest impression. According to some, the quiescent and recipient cell (ovum) opens outwards to receive the sperm cell, but the microscopic observations on this subject are neither exhaustive nor conclusive. But I think that, even should later research bear out in full present testimony, a simple mechanical explanation will suffice. The resting or receiving cell is about to divide; the outer surface is therefore, if not already fractured, at least excessively delicate. The nearer the spermatozoon approaches, the more is there a reciprocal attraction due to mass, such attraction being one of the modes of force in this universe of force—this force-universe. It is this attraction which would produce the fractured protuberance into which the spermatozoon half propels itself, and is in turn half drawn or sucked. As a matter of fact the speed of the sperm cell in the direction of the ovum is accelerated shortly before reaching its destination, although the undulating movement of its cilium is in no wise influenced, a fact which would go far to substantiate the above hypothesis.

As soon as a spermatozoon has entered such a cell (the ovum), which has a dimension of 0.5-0.1 mm., a chemical reaction takes place of such kind that the now saturated cell can no longer absorb, it hardens, forms an outer shell, and other spermatozoa strive for entrance in vain.

If, however, ova be artificially intoxicated they will receive, or are capable of receiving more than one spermatozoon each, thus increasing fertilization. The intoxicant is evidently a medium and environmental influence to prolong the original nature or characteristics of the ova, just as water is a medium which brings the motion of the sperm cell to a precipitate end, and bends or curls it

[1] "Licht und Leben," p. 257, by Prof. Büchner.

up into a ring. Perhaps some day these facts will be made use of in the rearing of various domestic breeds.

The nuclei of sperm cell and ovum fuse. This fusing is called fertilisation, because the free-swimmer, including its nucleus, has had opportunities of absorbing matters quite foreign to that of the ovum and which accelerate and change the activity.

> "It has been further established that the double nucleus of the fertilised ovum is accurately composed half of male and half of female elements. When the egg divides into two, the nucleus of each daughter-cell is again half male and half female, and it is probable that this exact dualism persists yet further."[1]

This action is to be likened to the breaking up of a diatom, where each of the outer shells divides. Is this action comparable to the purely physical phenomenon that occurs on breaking an artificial magnet, in which instance, although the magnetism is so applied that one end of the bar is a north pole and the other a south pole, yet the place of fracture (the centre or other part of the bar) produces a north and a south pole?

Certain lower members of the vegetable kingdom also conjugate in similar wise, but the separation of the sexual cells has evolved by degrees,[2] and the combination of male and female cells, besides being found in most flowering plants and in grass, is often seen in one animal, as in the hermaphrodite gland of the snail, in the leech, which has both ovary and testis, as also in the ascidians, where, however, the sexual cells not being simultaneously ripe, self-fertilisation is prevented,[3] in the fluke and other parasitic flat worms where self-fertilisation exists, in the worm Sagitta[4] and other worm types, bivalves, cirripides, cœlenterates, and sponges, the fishes chryohrys and serranus, the hagfish Myxine and all the tunicata. Hermaphroditism is seen abnormally even in amphibians, which may have ovaries on one side and testes on the other.

The principal agent in the transition process from hermaphroditism to unisexuality has been, according to Sutton, the hypertrophy of one part over another. Darwin says,[5]

> "as in the case of flowers, I have as yet failed, after consultation with one of the highest authorities, namely, Professor Huxley, to discover

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[1] *Vide* p. 158.

[2] *Vide* pp. 154-155 and the footnote [1] on the latter page.

[3] A sexual reproduction by budding is common.

[4] The reproductive organs of this worm are well illustrated in Geddes' "Evolution of Sex," p. 114.

[5] "On the Origin of Species," by Charles Darwin, M.A., p. 101; pub. John Murray, London, 1859.

a single case of an hermaphrodite animal with the organs of reproduction so perfectly enclosed within the body, that access from without and the occasional influence of a single individual can be shown to be physically impossible. Cirripides long appeared to me to present a case of very great difficulty under this point of view; but I have been enabled, by a fortunate chance, elsewhere to prove that two individuals, though both are self-fertilising hermaphrodites, do sometimes cross.

"... But if in fact, all hermaphrodites do occasionally intercross with other individuals, the difference between hermaphrodites and unisexual species, as far as function is concerned, becomes very small."

All these things are, of course, long since general knowledge to scientists at large, and only here mentioned as links in the chain.

In the case of Aphides, a family of small "plant-lice," there is an example of parthenogenesis, or reproduction without fertilisation, *i.e.* of unisexuality, which is, however, in general not permanent, *i.e.* there are also periods productive of males and females. This change of structure is called 'Alternation of Generations,' and was first noticed by the poet Chamisso in a group of ascidians. It is well seen in the tunicates *Salpa* and *Doliolum* and in the fluke (Fasciola hepatica).

In Aphides, both the sexual and the asexual forms seem to be dependent on temperature and food supply, and

"warm weather and abundant food are conditions which result in the production of parthenogenetic females, whilst scarcity of food and cold weather cause the re-appearance of males, and consequent sexual reproduction. Thus Réaumur succeeded in rearing above fifty parthenogenetic generations, all descended from one mother, by keeping up for three or four years an artificial summer. The experiment has been often repeated, and the viviparous parthenogenesis retained for even longer periods. The viviparous females are frequently equipped with wings, which are generally absent in the egg-laying forms."[1]

The winged insect has a longer and thinner body and a different head than the wingless one, and varies in many other ways,

"especially in the simplified structure of the reproductive organs, from which the young are developed by a process comparable to internal budding."[2]

Thus, here again, environment has done the wonder, and there is actually quite another being. As we know how easily aphides can fly from clime to clime, it is conceivable that such changes could obtain a permanency, at least so long as climatic conditions remain the same in the new country, and that is all we can say of any living thing. Nay more, be a thing dead or alive,

[1] *Vide* "Chambers' Encyclopædia," art. 'Aphides.'

[2] *Ibid.*

and conditions alter its status, it remains in this altered status so long as the conditions which brought about the alteration from the original remain constant.

Climatic and food change, as also a variation in the amount of salinity in the environment, are responsible for the metamorphosis of the amphibian gilled axolotl to the gill-less and lung-breathing amblystoma, observed first by Dumeril in 1865.

The bacterium, Cladothrix (cited on p. 156), and the brine-shrimp (*vide* p. 151) are further examples. These should be sufficient, though they could be multiplied, nor is it necessary to enumerate in detail other causes for changes which actually occur in nature.

Fact is fact.

How then can McKinney so positively and dogmatically assert that

> "A sheep has always been a sheep, and will be a sheep so long as there is a man upon the earth."[1]

The premises lay all in the other direction, *and I leave to him the onus probandi.* A sheep has most likely, like many another animal (the cat, the dog or the horse, for example), evolved in long ages from the simple protoplasmic monad; and in all probability sheep will either become extinct or further evolutionise or degenerate. A standstill or persistency of species is not to be expected.

Even in the Pentateuch (Lev. xix. 19) can be read,—

> "Thou shalt not let thy cattle gender with a diverse kind,"

from which it would seem that cattle had even then a tendency to cross-breed and form mongrels or new breeds, and not to keep to a pure stock,—an existing tendency which the Egyptians had artificially raised to a 'fine art' in the rearing of abnormities. But not only in cattle is there a tendency to 'cross-breed,' but in living things generally, including the vegetable kingdom, and the above-quoted verse by implication expresses this, saying:

> "Thou shalt not sow thy field with mingled seed";

an idea to which yet more distinct reference is made in Deut. xxii. 9,

> "Thou shalt not sow thy field with divers seeds; lest the fruit of thy seed which thou hast sown, and the fruit of thy vineyard, be defiled,"

whilst the very tendency of nature to actually produce a cross 'twixt the vegetable and the animal kingdoms is guarded against by the further injunction found in the above verse of Leviticus as also in Deut. xxii. 11,—

> "neither shall a garment mingled of linen and woollen come upon thee,"

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[1] "The Origin and Nature of Man," part iii., p. 82.

which we also find in the selfsame verse of Leviticus, and which most probably points to this mixture being more conducive to the lichen diseases than would be a vestment of pure wool.

The maintenance of pure stock is evidently more artificial than forming new conditions.

But long before Moses' time, Jacob is mentioned (Genesis xxx. 37-42) as making some tricky and cunning manipulations with certain boughs of trees at breeding time, to ensure himself, at Laban's expense, of the majority of his father-in-law's flock, by making them "ring-straked, speckled, and spotted"; but the scientific value of this narrative is as good as *nihil*, seeing that the adaptation of the outward appearance of animals to their surroundings, although a fact (as in the case of animals which had a dark colour becoming light or white in arctic regions), takes a longer period to be carried out than Old Testament history gives us, and the mere placing of partially peeled or striped rods in the neighbourhood of the drinking troughs was quite insufficient for the purpose of integumental modification. On the other hand, the chemical action of the saps of certain woods in the drinking water is also very doubtful, and impossible with the woods mentioned. The older version gives these as green poplar, hazel, and chestnut, whilst the new version has them as fresh poplar, almond, and plane. In the margin, the Storax tree is substituted for poplar. The name Storax tree is very ambiguous and may either mean *Styrax officinalis* or the *Liquid-ambar orientale*, which latter, as far as geography and translation can form a basis for an opinion, is probably correct. The three trees mentioned are therefore, in all likelihood, *Liquid-ambar orientale*, the almond (*amygdalus communis*)—often named elsewhere in the Bible—and the plane (*plantanus orientalis*). The amygdalin ($C_{20}H_{27}NO_{11}3H_2O$) contained in almonds, with the aid (fermentating agency) of emulsin (the essential constituent of the vegetable albumen of almonds), breaks up in water into the volatile oil of bitter almonds, prussic acid, grape-sugar, and water; but neither amygdalin nor its decomposition products, either with or without the cinnamic acid, styrol, styrene (phenyl-ethylene C_8H_8) and ethers of the Liquid-ambar orientale would produce the desired effect, and I know of no constituent of the plane tree which would have such properties. If therefore such a piece of Jacoban jugglery was practised it was, at all events, not accomplished by the media stated.

But there are, natheless, authentic accounts of differences in sheep, brought about by human agency.

James Macdonald writes that sheep are

> "so nearly allied to goats, that the propriety of generic distinction is very doubtful,"[1]

and relates that even domestication of wild sheep has tended to produce actual physical changes, such as

> "to cause *the disappearance of the outer long hair* and to produce instead an increase of the length and abundance of the wool. . . . In some tropical climates the sheep loses its abundant fleece, and is covered with hair little longer than the ox."

Scarcity of food will lengthen the period for lamb-dropping, whilst food supply will hasten it, and there is no doubt that breeding has altered the characteristics of sheep in many ways. Apart from the fact that such diversities could have been slowly wrought in the usual order of things without human aid, the point seems to have been utterly lost sight of, *that man's acceleration of such changes is not really artificial, but brought about quite naturally, since man himself is natural, and what he does is natural according to the character of the forces of which he, like all matter, is formed, and in which he moves.* Man is just as much a part of environment to lambs, as sea-spiders are to Hydroids, snails to coral, Annelids to Antipathes, or crustacean parasites on crustacean hosts.

Again, man himself has been altered by climatic influence, physical changes and domestication. In sheep there is a deviation from the original stock not only as regards hair and the lambing season, but by the right and sufficient foodstuffs and other means, fecundity is enhanced,—ewes which formerly dropped but one lamb now frequently have twins and even triplets, whilst the breed known as 'Dorset Horn,' ewe twice instead of once a year.[2] see appendix (2) p 393 The quality of flesh has been altered by crossing, as instanced in that of the Oxford Down breed, which is a blend of the Cotswold and Hampshire breeds, the Hampshire again,

> "originating in a cross between the Old Wiltshire horned sheep and the Old Berkshire Knot with the South Down."

The shape of the head, number of horns,[3] the shape, thickness, length and weight of the tail can be varied at pleasure. Lastly, it must not be forgotten, that the genus he-goat (*capra*) and the genus

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[1] *Vide* "Chambers' Encyclopædia," art. 'Sheep.'

[2] It is want of sufficient food that is the cause of bacteria multiplying by spores, instead of by the ordinary vegetative processes; it is nutrition or the want of it that, as in the case of hydra, fixes sexuality or asexuality, whilst in the instance of aphides, not only is the kind of reproduction determined, but actually limited to females.

[3] Icelandic and North Russian sheep have often as many as five horns, whilst the Hampshire and several other breeds have none at all.

ewe (*ovis*) have been so successfully crossed, that the progeny has been fertile for several generations.

But McKinney, on page 83, formulates his case somewhat differently. His sheep becomes an elephant, and of this animal he says :

> "There is not the slightest ground for supposing that protoplasm capable of forming an elephant can ever, by any change of circumstances or surroundings, lose its power to produce an elephant and gain the power to produce a different animal."

This is rather begging the point, but even here we will not flinch. To be Hibernian, 'There is nothing like taking the bull by the horns,' even though the bull be an elephant. If the protoplasmic cells from the testis of one animal be injected into the ovary of another species of animal, a mongrel is brought into the world. If many such mongrels, all alike, were bred, and these allowed to come together, the mongrel would be perpetuated and have a nature different to either of the parent stock. This artificial process of crossing does not often take place in the usual course of things, but the fact is sufficient to contradict McKinney, and exceptional cases do actually exist. As in the case of the sheep too, man may be considered as the environmental influence. Generally speaking, the protoplasmic cell produced by an elephant has certain hereditary tendencies, and not suddenly could it possibly produce anything but an elephant. But climatic, physical, and chemical changes, as also variety of diet, could produce an elephant differing in many respects from the original progenitor. The history of evolution is full of such departures. The new variety or species can be driven by geological changes, earthquakes, volcanoes, river-bed alterations, and the like more to change its abode, and then to cross-breed with another, deviating only slightly from itself. Thus in a long line of differentiating generations, an animal may well come to exist, in no respect similar to the creature now known as an elephant. Various fishes have actually been known naturally to intermix, as have also various species of toads been seen in the act of copulation.

Environmental influence have, in many instances, been sufficient without cross-breeding to produce a like result, although it required a longer period to attain it.

But McKinney's statements, both as regards the sheep and the elephant, are quite at variance with a less arbitrary but no less dogmatic sentence on page 79, which *ad verbum* runs :

> "If man is able to transplant the spurs of a cock so that they grow out of the comb, we need have no difficulty in believing that the

creator developed seals from bears.[1] The essential point is to see the hand of God in the work."

In like wise he expresses himself on page 37:

"There is evidence of general progression, which may be called evolution: but each new species was produced by special interference of the Creator."

The fact of the matter seems to me—until I receive proof to the contrary, and I am open to conviction—to be that Mr. McKinney is blowing hot and cold because he does not quite know his own mind.

It has, however, I think been clearly and lucidly illustrated in the course of this chapter, that environment in the form of molar or mechanical, chemical, molecular or physical, and vital or animate influence or agency can and does alter species. This work, up till now, has shown us that there is no such thing as a creator or one that can form something out of nothing, but that all matter and all free forces are but modes of one all-pervading force, ever in action, there from all times and from all eternity.

Environment is but another expression for the collective force-forms round and about any given mode of force or forces. Every force-form has an environment of, or is environed by other force-forms, such forms of force being a condition of being,—characteristics in the eternal existence of the one all-pervading force. Every part of it to all infinity was there in some mode or other from all eternity.

No special interference of a creator took place, firstly because a creator was not, and secondly it was, as this chapter has shown, not necessary, as all that has taken place did so as the action of this 'Universal Force' in its many modes.

Vice versâ, the position might be stated thus:—A creator is not necessary, and what is not necessary is not real (*vide* pp. 59, 60), therefore is a creator no reality, *ergo*, he is not.

I would ask with Herbert Spencer:—

"Which, then, is the most rational hypothesis?—That of special creations which has neither a fact to support it nor is even definitely conceivable; or that of modification, which is not only definitely conceivable but is countenanced by the habitudes of every existing organism?"[2]

Let us leave Mr. McKinney as a side issue (dying out), and take up our parable where we left off.

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[1] Not in keeping with observed facts.

[2] Herbert Spencer's "Essays: Scientific, Political and Speculative," p. 4, ed 1891.

Up till now, although standing on a height, built up of the through long ages accumulated dust of once living unicellular matter, and surveying the distant confines of the vast animal kingdom, we have not sufficiently viewed the strange scene in our vicinity.

See! Wild, uncurbed individual roaming, single flights, and free love are being gradually checked. Communities are forming. Dense swarms of bacteria are becoming

> "Fixed in a matrix of their swollen contiguous cell walls, and pass into a resting state as a so-called zooglœa."[1]
>
> "Their formation is due on the one hand to the aggregation of resting bacteria, arising from one mother cell or from several, and on the other hand to the thickening and gelatinisation of the individual membranes,"[2]

which they have in common with the algæ and fungi.

These membranes, which encircle the protoplasm or living albumen, are either of cellulose, as in the cell-walls of plants, or more often of the albuminoid mycoproteïn.

These jelly-like continents or zooglœæ, which can attain a foot or more in size, may contain myriads of colonies. The continent formed by the bacterium *Cladothrix* often forms a ramified structure and, as such, is essentially a plant. The zooglœa of *Crenothrix* is a round disc, of *Beggiatoa* an oval one, whilst by the division of cells taking place in several planes in *Bacterium merismopedioides* plates are formed, and in the instance of *Sarcina ventriculi* three planes being set at right angles to each other, the structural formation is cubicle.

> "But in addition to these entirely vegetative processes, bacteria also reproduce by means of special cells—the spores. The contents of the units contract, become rounded off, and surrounded by a membrane. It is a special case of internal (endogenous) division, and has been observed in cocci,[3] rods, and spiral forms. In some cases, such as *Clostridium butyricum* of butyric acid fermentation, the cells which will give rise to spores can be distinguished from the others before the spores have begun to appear. Spore-formation appears to set in as a response to insufficient nutrition."

Similar actions to zooglœæ formations take place with animal cells:

> "The same habit of aggregation is not uncommonly exhibited by single unicellular organisms, and also by the cells of higher animals,

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[1] Prof. Halliburton's "Chemical Physiology and Pathology."

[2] "Chambers' Encyclopædia," art. 'Bacteria.'

[3] The spherical forms.

[4] "Chambers' Encyclopædia," art. 'Bacteria.'

> though in these cases the individual units fuse more or less completely to form a composite mass or plasmodium."[1]

The gelatinous medusæ are good examples of quite loose colonies of cells. These bud out from the polyp, but here the one animal, polyp, *is a distinct individual* from the other, the medusa or jelly-fish that evolves of it. The polyp, with the exception of the hydra, which is its prototype, has never sexual organs and multiplies or reproduces by budding and fission, and continues these processes long after the medusiform person has separated[2] from the hydriform person and has developed on its own account nearly all its distinguishing features, inclusive of its reproductive organs. This is seen very nicely in the case of the common jelly-fish of our coasts, the *Aurelia aurita* and its polyp *Scyphistoma*. That the independently swimming medusa has evolved of the fixed growing polyp is seen in some primitive forms, in which the medusa is still found mouthlessly clinging to the polyp, or is even a 'sporosac' or bud of it, containing sexual products.

The fertilised ovum undergoes segmentation, *i.e.* at start breaks up into a group of cells which remain together. *E.g.* in the case of a hare, a zooglœa of 96 cells is formed seventy hours after fertilisation. The round clump of cells, at first solid, soon sheds a kind of liquid, *i.e.* the chemical action of decomposition is taking place. This process appears, however, to be but of the nature of a fermentation, for the decomposed parts soon themselves become constructive agents. The round continent sets itself into colonies three deep, each colony again grouping itself into families. Each of the main layers develops on its own account, but only in one direction, and the whole procedure may be compared to a series of advanced and developed stages in filamentous structures such as form in algæ (*spirogyra*, etc.), the filaments forming in three extended planes at right angles to each other. The uppermost layer is termed the 'epiblast' or 'ectoderm'; the second or middle one, the 'mesoblast' or 'mesoderm'; and the third or undermost layer, the 'hypoblast' or 'endoderm.'

It must be noted, that this three-layer system does not form immediately into the positions into which it is at the present moment seen, these having previously assumed a two-layered sacklike form called a 'gastrula,' which is really nought but the hollow ball of cells or

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[1] "Chambers' Encyclopædia," art. 'Bacteria.'

[2] The medusæ of the class *Hydroidea* is produced from its polyp by gemmation of some *Acraspeda* by transverse fission, etc.

'blastosphere' bent inwards, originally may be by simple indentation. The inner hemisphere (endoderm) gradually falls back on the outer (ectoderm), forming two layers, the inner of which is ciliated. This construction is seen the simplest in the earlier sponges.

Instead of by this 'invagination,' the two-layered sacks may arise by an arrangement of the cells, as when the oval ciliated free-swimming larvæ, embryos, or 'planulæ' evolve from the eggs of medusæ (hydrozoa) "by a process of internal differentiation known as 'delamination.'"

This gastrula was originally nearly round, but on account of the opening in the ball, could easily compress by outer pressure, giving it by degrees an oblong shape. This modification in shape was most likely accelerated by an increase in the number of cells around the orifice,[1] thus lengthening the entire. The fact that the growth of individual cells is lengthwise, may also have been a contributing factor to the same end. At all events, by one or more natural causes, an evolution in shape occurred, analogous to the artificial evolution of the narrow-pointed randan skiff, or the sculling boat, from the first boat in the form of the clumsily cut-off trunk of a tree, over which the prehistoric man simply set himself astride, and which was followed up by the three-stemmed catamaran. By lengthening the shape, and pointing the extremities, locomotion is facilitated.

The gastrula is the origin of the shape of our bodies, for the narrow opening or 'blastopore' formed at the narrow aperture of the sack (the longitudinal section of which is a horse-shoe) is the origin of the mouth, whilst the cavity leading from the mouth of the sack inwards, gave rise to the stomach. Digestion was carried out by simple absorption of food matters, and an anus for the passage of the fæces was of later development.

Such primitive mouths and stomachs are seen in hydra, hydrozoa, corals, and so on. Even in human infants, exceptionally, an anus closed by skin, or more rarely by flesh, is formed which prevents the usual evacuations, and the child then nearly represents the hydra. Not quite, however, for the child would die if not operated upon, owing to it not being able to part with its meconium or matter first discharged from the bowels of a newly-born babe; although probably liquid food might otherwise have sustained it.

Some animals have developed more than one excretory canal. The *Ctenopora* (sub-class Cœlenterates), for instance, has two anal apertures.

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[1] The cells gathering around the mouth of the protohydra and microhydra produce the arms or tentacles of the hydra, and further develop to the antennæ of insects.

In the hydra there are three cell layers, the middle or mesoderm of which is but a thin structureless lamella and but a faint suggestion of future development, whilst the ectoderm has six varieties of cells, and the endoderm three. In the higher animals the ectoderm gives rise to the epidermis and nervous system, the envoderm to the lining membrane of the alimentary and respiratory cavities and the cells of the digestive glands, and the mesoderm to the rest of the body. Further developing, the cells become modified and altered to form hollow blood vessels, the long muscles, horny epidermis, the mucin-yielding cells of the salivary glands and so on.

Also the cells, by degrees, part to make room for intercellular substance. The spine vertebræ become formed, and degenerate at one extremity and form the skull, and the brain grows within this; that brain which rules man and brute, and makes use of the so-called inorganic matter and of many of the free forces of the universe.

Thus far has the scientist of to-day advanced.

From this vantage ground, the domains of Evolution and Embryology can, in the general aspect, be overseen. It is unnecessary, however, to wander into these regions, as the various points of interest can be so easily studied from the able works of such well-known authors as Haeckel, W. His, O. Hertwig, etc.

The chief feature of the scene before us is that the most complicated and composite multicellular organism, including man, is descended in direct lineage from the unicellular organism, and that this again is made up of the same inorganic substances that go to form our earth and our atmosphere. Our earth and our atmosphere are but special combinations and modes of the Universal and Eternal Force, and their immediate existence in general, if not in exact detail, well accounted for by the aggregation, and later on segregation, of diffused matter on the now, in nearly all scientific circles fully accepted nebula hypothesis.

As to the physical condition and properties of the forces or rather force-forms of the universe or a part of them, prior to their assumption of the form 'matter,' and how they came to assume that form, we can at present know but little. But the merest tyro—and not only the man of science, as Spencer would have it—must see that momentarily

"absolute knowledge is impossible." [1]

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[1] Spencer's Essays, "Progress: its Law and Cause," p. 62.

Spencer continues :—

> "He alone" (the man of science) "knows that under all things there lies an impenetrable mystery."[1]

It is not, I believe, going too far, to claim for the statement: 'a being with finite powers of obtaining knowledge is incapable of intellectually fathoming infinity,' the position of an axiom.

Man—at least in the present state of his existence—has, by virtue of his finality, but finite powers of obtaining knowledge. But Spencer accognises this truth too late. Although acknowledging the impossibility of its acquirement, he had striven for absolute knowledge. He had sought to pierce and cut his way through the subtle meshes of an "impenetrable mystery" that by him unseen yet sensed, seemed warped and woven within, round and about every fibre of his person and personality. Having but finite powers of endurance, he becomes tired, worn out, dazed and giddy in essaying the maintenance of this unequal and impossible struggle against infinite force; he no longer sees where he is striking; the right valiant blows of his truncheon "fearless inquiry"[2] are dealt at random; he begins to misunderstand his surroundings; his once clear brain reels, and soon he is labouring under the strange delusion that impenetrable mystery is after all to be comprehended. Mystery is to be a guide to himself and to others hereafter!

> "Fearless inquiry tends continually to give a firmer basis to all true Religion,"

he cries:—and in impenetrable mystery alone, which he has found, in the absence of absolute knowledge he accognises a "firmer basis" of religion, he finds a support and a stay.

What a sad picture! It is no longer Spencer the philosopher who is there, prostrated, panting, and exhausted before us; it is Spencer, a poor mystic, his energy spent, clutching at a phantasmagoria, imagining he had at length gained a firm footing where, of a truth, he had found all receding from before him, receding into—mysterious infinity.

Oh, Spencer! herein archetype of the religious man for thousands of years, great art thou, brave, noble, and true. But great is thy fall, and thy disciples fall with thee. Eh, man! it was a grand last rallying round the old standard embellished with new jewels,

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[1] Spencer's Essays, "Progress: its Law and Cause," p. 62.

[2] *Ibid.*, p. 60.

[3] *Ibid.*, p. 60.

but retaining its antique and now antiquated device, '*Quod nec omnia, nec omnium causæ, nec quid omnia sunt, scimus, ergo Deus est.*'[1] But the cause was a lost one. How could it be otherwise, when the fighters went out to strive with infinite force? This impenetrable barrier was to them as a mirror, in which they saw true nature reflected. Time after time they returned to the charge, each time to meet but themselves and the reflection of truth. They wounded but themselves, and strove for an image, whilst truth—the substance—towered from behind them. They failed forsooth, because their supposed divine guidance was after all only a negation, merely a "profound" conviction "that the universe" was "an insoluble problem."[2]

Spencer's religious proclivities built up the funereal pile of which he himself was the mighty holocaust. He was to his cause what Charles Kingsley's Hypatia was to hers.

And the lesson to be learned? It is a sorry religion indeed, the sole prop of which is ignorance.

But mind, readers mine! I do not herewith, with one stroke of the pen, obliterate the word 'religion' from this page. I only expressed the opinions that infinity could not be penetrated, and that mystery alone is not a sufficient foundation on which to build up a Religion.

To work! To work! Right about face. Truth was behind. Clear the space bespattered with the brains of your fallen heroes, which separates you from it. Use your will to defecate the atmosphere about you, and the result will not be wanting.

Why has the truth not yet been found? If you will find what others have not found, then do not forget our motto:—"Search the Scriptures, watch, and pray." We have been searching, we have been watching, we have not been praying. Pray for guidance to find the truth, pray, pray, pray. "Who to?" To the Universal Force, of course, to The Omnipresent Eternal One. Remember the pretty words of Helen Lindsay:—

> "If you are at present unable to see that the Bible contains God's truth, at least remember this:—God's being is not *dependent* upon the Bible. Close the pages of your Bible, lock it away in the cupboard if you will—you can still hold communion of spirit with Him whose Being all the universe joined in proclaiming Lord of all—call

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[1] Eng., 'because we neither know all things, nor of all things the cause, nor what all things are, behold God exists (is).'

[2] Spencer's Essays, "Progress: its Law and Cause," p. 61.

him God, Motive Energy, First Cause, what you will, He is present, around you, within you, everywhere."

But is it any use, any purpose, praying? To this I answer "Certainly." Others have prayed, and may be you have prayed, and so have I. It has been herein proven that all which exists has its purpose, is necessary: therefore prayer existing, it also has a purpose and is necessary. Pray by all means; let us pray.

For what shall we pray? For present needs of course, for strength to complete the task we have set ourselves: the task of finding out what place we take in this universe round about us. We may never hope to follow even an endless line, yet can we be perfectly satisfied if we are able to conceive that a line lies before us and that we accognise its infinity. So, and in such wise, may we know what nature is, and perhaps herefrom what divinity is. May our first effort be crowned with success, that for a solution of the riddle of life.

There are certain characteristics which have been attributed to living matter.

According to Prof. J. M. Baldwin,[1] 'Life' is—

> "a form of organisation found in certain material things, having the properties of self-perpetuation for a longer or shorter time, and of reproduction in some form, and further distinguished by certain characters described as vital properties or properties of living matter."

This definition is somewhat lax in expression, and is therefore wanting in perspicuity, for 'self-perpetuation' and 'reproduction' are as much, though not more, vital than, say, 'irritability.'

Prof. C. F. Hodge[2] thus enunciates the qualities or conditions of living matter:—

"(1) Nutrition including anabolism and katabolism.

"(2) Reproduction: the power of changing dead (food) matter in itself, thus reproducing itself and increasing in amount up to the limit of the food supply. All known living matter has thus arisen from previous living matter.

"(3) Irritability, incl. the fundamental functions of conductivity and contractivity: the property of living matter by which it is enabled to respond to stimuli, *i.e.* to maintain continuously internal adjustments to external changes, an essential characteristic of life."

This is a very unsatisfactory summing up, seeing it does not only make statements but draws inferences, inferences which—as are in fact all deductions of such kind—open to criticism. The word

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[1] *Vide* the "Dictionary of Philosophy," art. 'Life.'

[2] *Ibid.*

'thus' should be left out in (2) and 'continuously' in (3) as should also the whole phrase "an essential characteristic of life."

The most concise and lucid summary which I have found is given by Prof. Halliburton;[1] whose enumeration of the qualifications of matter necessary to its conditions of being 'alive' is—

(1) Power of motion—by stimuli. Irritability.
(2) ,, ,, assimilation.
(3) ,, ,, growth.
(4) ,, ,, secretion.
(5) ,, ,, excretion.
(6) ,, ,, reproduction.

To this I shall therefore adhere as a basis for my criticism, although I shall not neglect the definition of Prof. Hodge.

One has to direct one's first attention to the examination of in how far the given characterisations are specific of living matter, *i.e.* whether or no these characteristics be shared by so-called 'dead' mass, and secondly, if living matter always has these properties.

(1) Power of Motion—By Stimuli. Irritability.

The electric current disassociates the particles of a wire through which it is passed. This is proven, in that if the current be strong enough, the wire will first of all glow, then melt, and in the end the molten metal pass off as vapour. We are aware of a similar action in the blackening of X-ray glass bulbs, which phenomenon demonstrates that the finely divided matter of the wire is being ejected from the kathode.

Now "Answers"—a very entertaining, but usually railway carriage sort of paper—has in its May 28th, 1904, number, a really earnest article entitled "Are metals alive?" wherein mention of the known fact is made, that tin or platinum wire is excited to give an electric current if tapped or twisted. This means that the particles of the mass of the wire are set in a given motion.

Professor Jagadisachandra Vasu (experimenting at the Faraday Laboratory in London), "Answers" tells us, first placed a piece of tin wire in pure water, and then excited it by the stimulus of tapping, whereupon it gave forth the usual

> "electric current, and a line of a certain height was drawn by the writing apparatus"[2]

to which it was attached.

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[1] "Chemical Physiology and Pathology," by Prof. Halliburton.
[2] "Answers" for May 28th, 1904.

"Then a little bicarbonate of soda ($NaHCO_3$) was dissolved in the water. This chemical had quite a stimulating effect on the tin wire, and so the electric current produced was stronger, and the line on the paper became longer. Next a depressant was tried, and the same drug which depresses our own nervous system, bromide of potassium[1] (KBr),"

depressed the tin wire, which, as a consequence, gave off less current and so shortened the line on the paper. Animal nerves are alive for some time after the death of the rest of the body, and experimenting with such a strip of 'live' nerve and a leaf-stalk, Professor Vasu found that both of these also produced electric currents on being submitted to the stimulus of tapping, which action can be enhanced by suitable stimulating chemicals, whereas an application of chloroform makes the current sluggish.

This set of experiments shows us that the particles of the tin wire can be set in motion by exterior stimuli. If the liquid bath be given an alternate increase of $NaHCO_3$ and KBr, one obtains alternately a quick and slow movement of the particles, which movement can be kept up as long as there is a sufficient supply of the respective stimuli.

Prof. Vasu further showed that a piece of muscle gets tired during continued use, but that it recuperates itself after sufficient rest, which same effect takes place with a piece of platinum wire. A similar action, I may mention, takes place every day with the batteries connected up with our household electric bells: continue to ring, and the Leclanché cells get tired, cease to carry out their functions, and have to take a rest.

Once more to quote from "Answers":—

"There are several drugs which if taken by human beings in small doses are stimulating, but if taken in large doses have the opposite effect. One grain of quinine two or three times a day, for instance, acts as a stimulant. But if doses of three grains and upwards were taken the effect would be seriously depressing. Now a piece of tin wire is affected in precisely the same way by solution of potash. When three grains in a thousand of water are supplied, the tin becomes more lively and gives off a stronger current; when thirty grains in a thousand of water are used the wire is utterly paralysed, and gives off no electricity whatever."

Nearly every one probably has seen in opticians' windows the rotations of the radiometer,[2] invented by Crookes in 1874, but no

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[1] "Answers" for May 28th, 1904. KBr is also used as a slow agent in photography.

[2] *Vide* Maxwell, "Scientific Papers," vol. ii., p. 681; Cambridge, 1890.

one seems to have paused to think what an apposite analogy there is between that little glass bulb and the gyres of its contents and the stimulated movements of living protoplasm, and yet it is by stimuli that the sooted vanes rotate, the stimuli being either heat (as in the case when warmed by the effects of the electric current in a wire) or light from some source.

Thus can it be shown that inorganic bodies, under certain conditions, can possess the power of motion by stimuli and irritability generally.

Isomeric change in the living organic world is also due to stimuli and

> "In various colloidal substances, including the albuminoid, isomeric change is accompanied by contraction and expansion, and consequent motion ; and in such primordial types as the *Protogenes* of Haeckel, which do not differ in appearance from minute portions of albumen, the observed motions are comprehensible as accompanying isomeric changes caused by variations in surrounding physical conditions. The probability of this interpretation will be seen on remembering the elements we had, that, in the higher organisms, many functions are essentially effected by isomeric changes from one to another of the multitudinous forms which protein assumes."[1]
>
> "If the sudden folding of a sensitive-plant's leaf when touched, or the spreading out of the stamens in a wild cistus is to be considered a vital action of a purely physical kind, then so too must be considered the equally slow contraction of a polyp's tentacles. And yet, from this simple motion of an animal of low type, we may pass by insensible stages through ever-complicating forms of actions . . . . until we reach the highest."[2]

The reader will see that "the property of living matter by which it is enabled to respond to stimuli" is not "an essential characteristic of life."

I cannot leave this subject without challenging Professor Hodge's further assumption (*vide* his third qualification of living matter, p. 175) that 'live' matter maintains "*continuously*[3] internal adjustments to external changes," which would be distinctly contradictory to the already cited statement of Spencer that "life continues only as long as the accidents of the environment are favourable." It is also contradictory to facts. *E.g.* the life assimilation[4] of most[5]

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[1] *Vide* Spencer's Essays : "Mr. Martineau on Evolution," pp. 374-375.

[2] *Ibid.*, p. 377.

[3] The italics are mine.

[4] Respiration produces warmth, which accelerates assimilation.

[5] The nitrifying Bacteria (in Prof. A. Fisher's group of Prototrophic Bacteria) are aëroboic, and assimilate the carbon from the carbonic dioxide of the atmosphere in

plants depends on the stimuli of light and warmth. Not only, as I have hinted on p. 145, may the rotation of cell sap be due to these irritants, but they are also the agents for facilitating the supply of carbon to the organism, and metaphorically are physical ferments, being in an analogous way suppliers of carbon as the physiological ferments are carriers of oxygen, both without apparently doing any injury to themselves The plant obtains its carbon by the chlorophyll corpuscles breaking up the carbonic dioxide (CO_2) of the air. This they can of course only effect when in contact with the air. During the winter's cold, the grains

> "collect in masses in the middle of each cell, and when the heat increases, they resume a position on the walls of the cells. . . .
>
> The presence or absence of light has also an influence on the movements of the grains of chlorophyll: in darkness more or less complete, these collect on the side wall of the cells, and when light is admitted they return to the walls of the cells parallel to the surface of the organ. In all cases, whether heat or light, or both together, act as stimuli, the green grains move from one position to another, not because they have any self-power, but are so carried by the more fluid contents." [1]

This is exactly analogous to the action to which I called attention in Crooke's radiometer. The rotation in this latter is caused by a pressure of the fluid against the delicately posed vanes.

Experiments near Bonn on the Rhine and elsewhere with electric arc light illuminating the corn fields at night have shown that a plant then lives quicker. Warmth, as in the hot-house, accomplishes the same ends.

Just so with the radiometer: it rotates quicker with a strong light. Quickly alternating light and darkness effects the speed of rotation of the apparatus, which pulsating result can be compared with the action of cyanogen in the living organism. If the light be sufficiently strong, the radiometer keeps on turning for some time

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the dark. There are also highly organised plants—such as the evening primrose or the tobacco plant (*Nicotiana finis*) which at night gives out such a delicious perfume, and other plants of the same genus (*N. atropurpurea grandiflora*, *N. macrophylla gigantea*, and *N. sy vestris*)—which seem to be negative in this respect, *i.e.* which open out at night, *i.e.* to which darkness is a stimulus. Still rarer in nature are nyctalopes or creatures who live more actively at night. We have such partial nyctalopes in the cat, the mouse, and the hyaena, more so in the owl and the bat, whilst the Portuguese explorer, Dr. Manuel Tglasias, has, according to the Chicago "Tribune" (I believe June 7th, 1905), discovered in South-Western Brazil in the dense forests lying between the rivers Purus and Jurna, an entire village inhabited by nyctalopes who sleep all day, being then completely blind. At night the men hunt and fish, whilst the women sew clothes with thorn needles or weave baskets of grass.

[1] *Vide* art., 'How Plants Grow,' by Prof. G. Dickie, M.A., M.D., in "Science for All," vol. i., p. 300; pub. Cassell & Co., Ltd., London, 1890.

after the light has been cut off (it adjusts itself internally to external changes), owing to the momentum given to the vanes.

A plant will live in the dark only up to a certain limit (although it grows [1] quicker), but continued darkness kills the plant outright and stops the radiometer's revolutions. There is no continuity about either.

Muscles and nerves get tired in time, nerves holding out much longer than muscles, which latter seem to undergo chemical as well as physical action, for Prof. W. Stirling,[2] on July 28th, 1905, at the annual meeting of the British Association, reminded his hearers of W. Ranke's researches [3] that if an extract made from the muscle of a fatigued animal be infused into that of a fresh one, the latter evinces all the characteristics known as the phenomena of fatigue.

A strip of platinum wire will give off current each time it is pinched only after it has been allowed sufficient time to recruit itself. On the other hand, a tin wire, like a nerve, does not tire for several days; but at last even it gives in.

In the case of the brine shrimp, it was environment or external stimuli that altered its kind, therefore its shape, and hence also its motion; and "an irregular fragment" of the metallic element sodium (Na)

> "thrown upon the surface of cold water will rapidly assume a globular form,[4] and roll along the surface with great rapidity." [5]

It is only a question of time, both as regards the living as the dead mass, and there is no such thing as continuity of action due to a stimulus. Temporary reaction to a stimulus, again, is, as we see, common to both the above conditions of matter: it is not "an essential characteristic of life." [6]

It is true that continuity of light will make a plant live quicker, but this is at the expense of its strength—of vital energies—and the seedlings with their generations sown and resown under the same conditions will at length fail to produce a plant at all.[7] An all too strong light or overmuch heat will cause life to slow down and die.

The sole distinctions between so-called 'living' and 'dead' masses as regards the power of motion by stimuli turn out to be but

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[1] To be discussed under 'Growth.'

[2] Dean of the Faculty of Medicine at the Victoria University, Manchester.

[3] *Vide* "Lehrbuch," by W. Ranke, 1865.

[4] Due to its environment, water.

[5] Wilson's "Inorganic Chemistry," p 358; pub. W. & R. Chambers, London.

[6] *Vide* p. 175.

[7] Explained under 'Power of Growth,' on p. 204.

(*a*) one of degree and of the amount of energy stored, (*β*) one of duration of stored energy, and (*γ*) one of degree as to the complexity and complicacy of action.

(2) Power of Assimilation.

I look up the meaning of 'to assimilate' in "Chambers' Etymological English Dictionary" and find the following definition:—

> "V. t. *to make similar* or like *to:* to convert into a like substance, as food in our bodies—n. 'assimilation.'"

i.e. 'assimilation' is the converting into a like substance, etc.

I turn to the article 'assimilation' in "Chambers' Encyclopædia" (1888), and there stands:

> "'Assimilation' is the process by which living organisms absorb nutriment and convert it into part of their own substance, solid or liquid."

Now there is nothing more misleading than these statements. The general reader is led to believe that 'living' matter is made of quite a different stuff to 'dead' mass, and that by some most wonderful and occult transmutation process, this dead material is conjured into living substance, while really all the time no such thing is occurring: the constituent elements of the 'live' body being in no wise different to those obtaining in the 'dead' object, be it organic or inorganic.

The only difference lies in the way in which these elements chemically or/and mechanically combine. When, for instance, it is said that plants and animals assimilate carbon (C), iron (Fe), phosphorus (P), and sulphur (S), it does not necessarily mean that these elements are in any way altered in their molecular, atomic, or electronic structure by being brought into contact with living organic matter, *i.e.* that a sort of transmutation is taking place, but that the fact that C, Fe, P, and S, being supplied to the living organic matter, these were chemically or/and mechanically combined with it, resulting in its maintenance and growth. The same applies to the assimilation of compound bodies such as albumen, etc.

Even should the expression 'assimilation,' in the light of later research come to be another designation for 'transmutation,' we can feel perfectly at ease, for then will the power of transmutation be common alike to organic and inorganic, to 'live' and to 'dead' bodies.

Already Spencer deemed the elements to be other than prime factors, for he distinctly says:—

> "There are no recognised elementary substances . . . spectrum

analysis yields results wholly irreconcilable with the assumption that the conventionally-named simple substances are really simple.... Were iron absolutely elementary, it is not conceivable that its atom could intercept ethereal undulations of eighty different orders . . . it (iron) must clearly be a complex molecule. The evidence thus gained points to the conclusion that, out of some primordial units, the so-called elements arise by compounding and recompounding. And this hypothesis is entirely in harmony with the phenomena of allotropy."[1]

Was Spencer a prophet?

Corpuscles called helium flee from a body, the residue of which is called radium. According to Prof. Rutherford, when all the charged particles have been emitted, the remainder is lead.

"The atomic weight of radium is 225: five Alpha-particles at least are known to be expelled during the successive changes that take place. If each of these is an atom of helium of mass 4, the residue must have an atomic weight of 205, which is exceedingly close to the atomic weight of lead. In support of this conjecture, he cites the fact that in all radio-active materials lead is present, and its amount is roughly proportional to the helium present. This would be the case if both of them are disintegration products."[2]

Even lead may be decomposing. Assimilation may perhaps later on be shown to start or accelerate such decomposition, and to make use of such products.

On the other hand, Beresford Ingram,[3] after considering that an element is made up of atoms, and atoms of electrons, contemplates the formation of these last into systems of so many hollow spheres,[4]

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[1] Herbert Spencer's Essays: "Mr. Martineau on Evolution," pp. 372-373.

[2] *Vide* "Knowledge" for April, 1905, p. 74.

[3] *Vide* "Knowledge" for December, 1905.

[4] These spheres of electrons are probably the cause of iron intercepting the undulations of 80 different orders.

This idea of the existence of hollow spheres of electrons is already mentioned prior to Mr. Ingram by Mr. Newman Howard in his article 'The Warp of the World,' in the "Hibbert Journal" for January, 1905, where on p. 287 he says:—

"It must not however be thought that these 12 or 20 shells with their inside supports express the number of electrons contained in each 'atom.' About 1000 have been counted in the hydrogen 'atom'; so that lithium contains some 7,000 and uranium 240,000. For each shell is a system, and each system is built up or sub-systems. There can, so to us it seems, be very little doubt that the minute projectile of which a hydrogen 'atom' contains 1000, is itself a complete system, much like the hydrogen 'atom' itself; and so on *ad infinitum*."

This last phrase '*ad infinitum*' it is which probably gave Mr. Ingram the title for his article in "Knowledge" for April, 1905, in which however, it is only fair to add, the numbers of Mr. Howard are in no wise corroborated.

Mr. Howard has only logically followed Spencer in his spectrum ideas when he says, in continuation of the idea that an electron is itself resolvable into smaller parts,

"it can hardly be a coincidence that we find in a spectrum of hydrogen a system of numbers suggestive of the numerics of the whole catalogue of the elements, that is to say of the whole universe itself."

This statement, Mr. Howard tries to prove by a sort of very ingenious scientific

sometimes with, sometimes without a more or less rigid centre, meanwhile classifying them as to their degree of stability according to the number of ions or electrons in the interior rings, and goes on to state,—

> "But this is exactly what we get in the periodic classification of the elements. Starting with lithium, and taking the elements in order, as their atomic weights increase, we find we go from elements of marked electro-positive nature to those of decided electro-negative, then suddenly it reverts to an electro-positive element and the gradation to the negative element starts all over again.
>
> "Thus sodium, which marks the sudden reversion from electro-negative to electro-positive elements, may be considered as containing the arrangement necessary to give lithium its electro-positive properties with another ring (arrangement) or rings, that have no odd corpuscles added on to it. If by any means, hereafter to be discovered, the atom of sodium could be robbed of its extra ring or rings, *as a whole*, we should expect the transmutation of sodium to lithium to have been effected."

Newman Howard[1] expects to achieve this transmutation by the swiftly gyrating "vortex rings" of one of these "complex electro-corpuscular" systems into those of another.

For the moment we stand dazed before these possibilities: these myriads of electrons evolving out of one gyrating mass only to lose themselves again in the fiercely whirling vorticæ of another, at first actually make us giddily reel, but we soon experience a mystic calm gradually overcoming our senses as we accognise a method and rhythm in these movements, and faintly as from afar, and as if the sounds had taken æons of ages to reach us, comes a murmur of unity and eternity.

But waken, waken! We must go on studying in Nature's book, and not fall asleep over its lecture, though the dreams be ever so sweet.

When a compound body is eaten, it is decomposed by the gastric juices, saliva, etc., some of which products of decomposition go to

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cabalistry; but the notion itself looks somewhat like a kind of inorganic embryology, which latter aspect is worth while keeping in view.

I need only add that the sub-division of matter *ad infinitum* is of course an illusion, an abstraction: deduced from the abstraction "Geometric law," of which Mr. Howard truly said that it

> "is absolute and abstract, qualifying all things, but nowhere found exact. There can be no geometrically perfect line in nature; for none is held except against odds . . . . For, as Mr. John Davidson finely said, Nature is an artist, not an artisan' (p. 292).

As impossible as that of a straight line, is the infinite sub-division of a mass of cubicle content. The only final solution of matter is to be found in the resolution of it into component forces to which it owed its existence.

[1] *Vide* art., 'The Warp of the World,' in the "Hibbert Journal" for January, 1905.

form new compounds with various parts of the body with which they have affinity, whilst others are unassimilable at the time and passed as fæces. I say at the time, because very often, a substance not to be assimilated, owing to a saturation with it, is easily absorbable when there is no such saturation with this material.

Assimilation is therefore no specific property or characteristic of living matter, for to state that such and such a body assimilates another is merely to enunciate the fact that the first has formed a compound with the second, either directly or indirectly, by firstly decomposing the second and then compounding with the products or one or more of the products of decomposition. *I.e.* when a living organism assimilates any material, it has simply evinced chemical affinity for it or the products of its decomposition, and the material so chosen is that which, when in compound, goes to maintain that physical condition called 'life.'

Thus plants assimilate nitrogen—the nitrogen going to form cyanogen (CN)—and carbonic dioxide (CO_2)—the carbon going to form the carbo-hydrates of the plant, including chlorophyll, the oxygen being set free simply because it cannot form a compound with any part of the living plant, nearly all the oxygen it requires being obtainable from the free oxygen and the water (H_2O) of the atmosphere and ground.

Assimilation is therefore that process by which parts of a living organism combine chemically or/and mechanically with materials brought into contact with it, in such wise that they take the place of similar matter lost to the living organism through decomposition or/and are wanting to parts of the organism unsaturated (i.e. capable of growth) with such material, such process helping to maintain those conditions of chemical equilibrium known as the 'life' of the organism.

But this status is found also in the inorganic world. When, in the example on p. 149, nitrous acid (N_2O_3) is in an environment of sulphurous anhydride (SO_2) oxygen (O) and water (H^2O), the nitrous acid decomposes to nitric oxide (N_2O_2) and oxygen, the latter joining a compound sulphurous acid (H_2SO_3) to form sulphuric acid (H_2SO_4). The oxygen of the air is then assimilated, but not its nitrogen, for which the nitric oxide has no affinity. Nitrous acid is again formed, again it is set decomposing, and again oxygen is assimilated, nitrous acid is re-formed, its spell of life prolonged, and this inter-action will go on as long as the oxygen supply in the air lasts, provided all other conditions are maintained. It was Spencer who (in speaking of the infusoria) said

Ida Joseph

". . . . life continues only as long as the accidents of the environment are favourable."[1]

We have a similar action[2] to that with nitrous acid, when sulphuric acid is in alcohol (C_2H_6O), for the sulphuric acid breaks up and re-builds. A like instance is seen with solid aluminium chloride ($AlCl_3$) when it is made the active agent in the reactions

$$\underset{\text{benzene}}{C_6H_6} + \underset{\text{benzyl chloride}}{C_6H_5CH_2Cl} = \underset{\text{di-phenyl-menthane}}{C_6H_5CH_2.C_6H_5} + \underset{\text{hydrochloric acid}}{HCl}$$

$$\text{or } 3C_6H_6 + \underset{\text{chloroform}}{CHCl_3} = \underset{\text{tri-phenyl-methane.}}{CH(C_6H_5)_3} + HCl$$

You will see that these cases are not in the least different to the non-living amylolytic (starch-splitting) ferment action of the ptyalin[3] of the saliva, which changes starch to sugar, or to that reaction which in the living organism causes hæmoglobin to assimilate that and in such wise as to produce oxyhæmoglobin.

One or two last words.

Assimilation cannot go on without the presence of an inorganic environment. It is not to me conceivable, although it may be so to others, that at any time life will be dependent solely on an environment of life; because I cannot grasp the idea that living products will ever decompose to living factors only. At all events, in the present state of existence, without water, assimilation is impossible, and living depends, in this respect, on non-living matter.

It were a great mistake, it is a popular fallacy, to imagine that each individual of living organism is capable of assimilation. The embryo plant, as the scientist knows, does not itself digest, it has its food digested for it by ferments. These ferments decrease as the plant develops, and only last till the plant can take care of itself.

(3) The Power of Growth.

The opening ideas for my remarks under this heading have been presented me in the first instance by listening to my dear wife's pianoforte rendering of Schubert's Grand Symphony in C Major; a work probably less beloved and therefore less known than his unfinished ones on account of its musical reality and ripeness. The following few

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[1] "Principles of Ethics," vol. i., p. 11, by Herbert Spencer.

[2] The following must not be confounded with such instances as where platinum black causes peroxide of hydrogen to give up an atom of its oxygen, or where manganese oxide (MnO_2, which is also black) aids the liberation of oxygen from heated potassic chlorate ($KClO_3$), both of which actions are probably of a purely physical character, and owing to an increase in the absorption of heat (necessary for a free liberation of the gas) due to the black colour.

[3] Ptyalin is most active at 40° C. Heat and cold have a modifying effect on the assimilating powers even of human beings.

expressions (pp. 186-191 and p. 195) on sound are an endorsement of some of my wife's ideas thereon, which were elicited from her in the course of a chat on this subject. I may here add that my conception on several crucial points to which up till now and hereafter expression has herein been given, owe either their being or complete development to the co-operation of my wife, with whom the questions at issue were verbally thrashed out before being penned on paper.

I was just now discussing musical reality. We do not want reality in music but ideal, the not attained. We do not yearn for the completely developed, the fully grown idea, but for the young growth with all its endlessly vast [1] potentialities. C Major Symphony is not only perfectly ripe, it is over-ripe and on the way to decay. But this comment is not part of my theme, and I must preface the above few observations by saying that they apply just as well to other musical pieces of a similar nature.

The composer forms an idea (a musical ovum), founded on something he has in one or other wise experienced (the nucleus). Sudden inspiration from within (budding) or from without (fertilisation) brings to birth the musical composition. Bar is added to bar (of course only the usual *Musica mensurata*), each bar containing so and so many notes.

There is an accretion of bars and of notes. But there is more than this; there is the gradual development of the idea, the growth by degrees of the harmonious tableau. Swayed perhaps by external surroundings (the environment) a part of these become absorbed into and become part and parcel of the whole. Thus there is assimilation and development going on beside each other. There is assimilation, for the exterior influences are not, as in a *pot pourri*, merely accepted or accreted in their primary condition, but digested and made to assume somewhat the form of the original motive. In many cases, however, the original motion has been to some extent reacted on by the outside forces.

Now the question we must put to ourselves is: 'Can we correctly speak of growth where there has accrued an increase of volume?' Let us discriminate.

The usual conception of growth is most vague, and it is generally defined as 'the increase in volume of a body otherwise than by accretion, and without change to its own nature,' and where 'body' is used in its widest sense including physical forces such as 'a body

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[1] The unknown always appears vast.

of sound,' etc. The ambiguity is not lessened by the fact that there is no statement as to whether the body be simple or compound.

I apply this definition, however poor, to Schubert's Symphony,[1] the music of which is, to jog my memory, just now lying before me on my table.

The following analytic treatment must be premised by the statement that there are three components (any one or more of which may be differentiated), to a body or volume of sound : (α) loudness—comparable to the breadth—(β) number of tones fused per minute of time—to be likened to the length—and (γ) pitch—analogous to the depth of a concrete mass.

The piece starts at once, without any introduction worthy of mention. The *andante* movement is as fitful and uncertain as any first growth, and its 25th bar is already a *decrescendo*, followed up by abruptly alternating *p*'s and *ff*'s. When once a single note is started, each consecutive one is an addition, an accretion, and the bars are simply taking account of the rhythm. There is, on page 3, a distinct acceleration of movement culminating, after 9 bars of 4 trioles each, *i.e.* 12 quavers or $\frac{1}{8}$ notes, in 4 bars of thirteen $\frac{1}{8}$ths (including one rest and one crotchet or $\frac{1}{4}$ note) and 2 final bars of thirteen $\frac{1}{8}$ths (including only one crotchet). This represents an increase in the fulness of sound, but it is not louder, it is in fact, from the 16th bar, a continuous *decrescendo*. Up to here therefore there has been (1) a development of the idea or a fused accretion of individual mental phases, (2) a from moment to moment accelerated increase in the complexity of the sound, the individuals of which can be separated, and (3) an accelerated accretion of separate tones.[2]

With the *Scherzo* (page 27), a more decidedly marked growth in bulk of the original conception is manifested. Without in the slightest loosening his hold on the fundamental principle, Schubert has here perfectly assimilated with it a new idea. But this growth in bulk as an entire, is actually, when analysed, but fused accretion : for it is not the old thought that has grown, but new ideas that have been digested, the components separated, and then beautifully amalgamated with the prime material.

But with bar 30 of page 28 (2nd page of the *scherzo*), a certain visible change comes over the composer's mood. Some outward

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[1] 'Edition Peters,' No. 126, Leipzig.

[2] (2) is the collective, (3) the individualistic conception.

influence is at work which makes itself marked by the complete fall of the *staccato* in the bass of bar 40, but against which he for a time strives, only to succumb yet further on bar 49, and henceforward this exterior influence, whatever may have been its anterior nature, is indelibly and inextricably interwoven with the ground function, but the original characteristics of both have been modified by this union. Bulk has increased, but not the original idea.

And now let us turn to page 49. With the 19th bar, Schubert starts the greatest *crescendo* movement of which I wot, setting out with 12 bars *ppp*. But this suddenly assumed softness is not a drop due to weakness, it is a veiled expression of pent-up energy, and the bass *tremolo* keeps up the fulness of the sound. There is moreover lacking that sign of feebleness, the *una corda* and instead, that pedal is in requisition which tends to a fusion of the tones, yet more enhancing the effect. This is succeeded by 8 bars without *tremolo* indeed, but *fp* and fuller chords in the bass, so that all in all there is an increase in the amouut of sound. As far therefore as the sound of the whole is concerned, it has grown, since it is louder and the individual notes have been fused or assimilated to an entire by the *tremolo* and pedal actions which allow of the vibrations coalescing. After *fp* there is indeed a fall to 12 bars *pp*, but the bass is increasingly gathering fulness although *tremolo* and then comes again 8 bars *fp* which after a second dip,—this time only to *p* —again after twelve bars rises to another *fp* of 8 bars, to be followed by 16 bars *mf*, capped by 8 *ff*'s which nearly reaches *fff*. Then for 44 bars there is a succession of slight alternate falls and rises between *fz* and *ff* until ultimately on page 51 *fff* is arrived at and maintained for 4 bars with nigh full chords, when there is a sudden sinking to *p* which is a weak point, denoting that growth of the idea is at an end. Although full chords and *fff* are again and again obtained (renovation) and there is in the left hand a rise of pitch caused by the use of the treble, which is assimilated with the bass by pedal, it is not the same thing. It is fitful rallying, losing, however, by a right-hand *tremolo*, and finally decaying into *fz*.

The alternate wave crests and troughs of sound at the outset of this last phase—12 *ppp*, 8 *fp*, 12 *pp*, 8 *fp*, 12 *p*, 8 *fp*, 16 *mf*, 8 *ff*, and so on—may be likened to anabolism and katabolism going on day and night in a young growing plant or animal. It will doubtless have been noticed that from start to finish of this *crescendo* movement, there has also been a tendency to increase the pitch, which, in physical phraseology, is an increase in the number of waves or oscillations per note per second.

And this brings me to another point. It opens up the question in what respect a single note can be said to have grown.

Strike C on the middle octave of the pianoforte. Put on the so-called loud pedal, and you have really only prolonged the vibrating of the wire, given an increased span of life to the note, but it has not grown. Strike the C an octave higher, and there is, it is true, an increase in the number of oscillations, of pulses, but the note is not the same. I mean to say, the one C is not the other C. If I strike the key more forcibly, *i.e.* louder, I have sounded the note twice—once softly and once louder—therefore here again the note is not the same, and not it, but another is louder. If you strike both C's together and put on the pedal, nothing has been done than to mingle on the instrument two distinct sets of vibrations, starting together, but immediately differentiating, only to join each other at their death, the one vibrating 264[1] the other 528[1] times, so that never *de facto* are the two effects perfectly fused by the pedal, as any physicist of acoustics can by experiment analytically prove, although to the ordinary ear only one sound is emitted.

The nearest analogy to our primary idea of growth is therefore evidently not to be found on the pianoforte.

As far back as 1856, Th. du Moncel had discovered the scientific principle that a finely vibrating body, *i.e.* one, the contacts between the particles of which were in an easily to be altered position to each other, offers a variable resistance to an electric current passing through it: that is to say, through the points of contact of the particles; which is essentially the principle of our present microphone. Thus, when a note is sounded through the microphone, it is very loud indeed, and even the footsteps of the fly are made audible. But even this is no true instance of growth; it is not actually the same sound increased. The louder tone is not the original, but a magnified reconstruction, reproduction of it. That originally heard is transformed to silent waves passing through the adjustment, and is reconverted, considerably augmented by other obtaining physical conditions.

"Eureka! I have it," I hear some one cry. "Sound the siren. Sound it in such wise that there is a constantly increasing speed in the rotation of its holes; the pitch grows." Do not be so sanguine. The pitch is raised, but it does not grow. All that has been produced is a constantly changing pitch, just as an increase in the

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[1] According to the Stuttgart Congress and Society of Arts, London.

number of light waves gives a variance of colour. There is a constant transformation, that is all.

"Then increase the pressure of the air supply through the apertures, and the note will be ever louder and louder: it grows louder." I am sorry again to contradict. This is a popular fallacy, or perhaps a linguistic idiosyncrasy on a par with 'the sun rises,' and so on. The result is really the same as in the case of a rise in pitch. The note is being altered, only instead of the number of vibrations, it is the degree of energy, the intensity, which is changing: a difference here somewhat cloaked indeed by our own faulty senses. So much so is this the case, that we are often hardly able to discern between rise of pitch and increase of loudness.

In this category of transformations may also be classed the sound emitted through a constantly varying shape or orifice, giving us continuously new timbre or quality of sound.

"But what of the resonator? Is it not the incubator, the growth producer of sound?" I hear asked. "Keep down a pianoforte key, leaving the other strings at liberty. Next, hit a note an octave lower. Dampen the strings of this last by liberating it, and the first note becomes as audible as if itself sounded, and the intensity can be repeatedly enhanced by reiteratingly striking a lower key of which it is an harmonic."[1] Not even here is there true growth, pure and simple, but multiplication, reproduction if you will, caused by an increased surface, each part of which is producing similar vibrations. Any student of sound will, moreover, tell you that there are conditions which are favourable, others which are unfavourable, to 'resonance' or sound reproduction.

I may add that no note is single, but made up of a fundamental tone blended together with other tones, which fundamental tone can again be analysed; or physically expressed:

> "No vibration of an elastic body is ever accomplished without a more or less well-marked division of the vibrating body into segments which vibrate independently and simultaneously,[2]

so that even should, at a later period, some one essay to prove the growth of sound, greatest scepticism is necessary, for each sound consisting of so and so many parts, there can be an increase or accretion of the number of harmonics or anharmonics per fundamental tone. This is another way of expressing an increase of

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[1] Paraphrased from an art. by Prof. Knott.

[2] "Chambers' Encyclopædia," art. 'Harmonics.'

timbre or quality, an idea already hinted at when discussing the siren.

Lastly, timbre can be effected and amended by 'temperament,' as any one knows who has listened to keyed and stringed instruments being played together.

Sound can be influenced by temperature.

This preamble, long as it appears, was requisite, for what is true of simple force, is essentially true of those conglomerations of force centres, which we call matter.[1]

And firstly let us treat of so-called 'dead' matter; although, as we have learnt, it is really in a constant state of motion, either centripetally running together, or gyratingly radiating interiorly and in straight or waved lines from the exterior of the main mass, besides having other motions due to special physical conditions.

The following, though quoted from a popularly written work, seems to be essentially the view taken by scientists in general, despite the fact that they themselves have discovered every proof to the contrary, but yet strenuously shut out from their minds all except that for which every vestige of evidence is lacking:

> "The dead or inorganic[2] matter of the world is everywhere being added to, and no less does the world of life exhibit a constant increase as its unvarying heritage."[3]

This statement that both live and dead matter on the earth are simultaneously increasing is tantamount to saying that mass itself is constantly being augmented. I challenge Mr. Wilson to supply me with one single scrap of proof that the amount of substance is rising. Dead stuff and live can only increase at the expense of each other—each being alternately the environment of the other—and where the one wins, the other loses. This, at least, is the present state of existence. Moreover, from the standpoint of radiation, there is no knowing how much matter may be completely resolved into its primary component forces. But pardon, I know Mr. Wilson thinks on this one point at least, as most others and I do, and only cite the above as an illustration of that laxity of expression which has prevented the majority at all events from grasping the idea, much less getting any clear conception of 'growth.'

The rudimentary notion of accretion is best exemplified in the

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[1] We have seen elsewhere (pp. 72, 78, etc.) that matter is a mode of force.

[2] Organic matter can also be dead (albumen, the proteids, the organic acids, and so on), just as the 'dead' elements can combine under conditions called 'life.'

[3] *Vide* art. 'Growth,' by Andrew Wilson, Ph.D., F.R.S.E., in "Science for All," vol. ii., p. 201; pub. Cassell & Co., London, 1891.

matter of mud, sand, and débris of all kinds, organic and inorganic, which collect at a river's estuary. Perfectly definite, but removed one stage from pure simplicity, is the instance of the conjugation of the whole dependent stalactite family with the upwards-striving stalagmite family as particles on particles of carbonate of lime, after bidding farewell to their whilom companion drops of water, who most thoughtfully make themselves scarce so as to be no hindrance to the union, fasten themselves on to the cave's roof and on to each other like so and so many African white ants, bravely letting themselves down little by little, till the members most in front kiss the first to arrive from below, and ere long (reckoning geologically) the entire two families are united in one solid bond, they form a pillar of lime. There is, in the above, the accretion of single particles to form groups called stalactites and stalagmites, and the accretion of the two groups.

An allotropic form, if I may term it so, of these stalactites, formed under enormous heat, is aragonite. This aragonite sometimes becomes crystalline as in satin spar, or collects its parts in an egg of very thin concentric hollow spheres which are continuously fused into each other. I have a very beautiful specimen of this in section before me, and the fineness with which nature works is here admirably shown, for the concentric lines are so close as only to be counted under the magnifying glass. Although their origin is so entirely different, how much they remind one of the rings in the section of a tree's trunk. Are the former, like these latter, the correct register of so and so many periods of time, long or short?

The growth of the leaden 'Tree of Saturn,' as also the arborescent dendrites of manganese formation, must be classed in this form of accretion. A shade in advance of these is 'Jupiter's tree,' which is produced by letting water slowly trickle down along a tin rod introduced into a concentrated stannic proto-chloride solution and letting it stand, whereupon crystals start budding from out that part of the rod not in the water. On a par with, if not ahead of this, is the somewhat different phenomenon—different only because of the different cause of its origin—of so-called weather fluids, which become turbid (throw down a precipitate) in bad weather. As atmospheric pressure and temperature affect the quantity of precipitate, the growth or accretion of this matter is dependent on external stimuli.

Now, take the case of a snowball. You can press more and more snow on it, and the more you pack on, the larger it gets. But if the ball be rolled along the ground, the weight of the ball itself aids in

the work of accretion, *i.e.* something in the nature of the ball is a part-agent. An iron magnet collecting or attracting other pieces of iron is an example of accretion caused by internal influence. But not only can iron, but also nickel and cobalt be attracted, though in lesser degree.

When iron and oxygen come together, there is said to be chemical affinity between the two. That is to say, two elements, one a mineral, the other a non-metallic gas, have the power of attracting each other, or, more correctly, the oxygen attracts the iron and forms with it new bodies—ferr~~ic~~ous (FeO) and ferric (Fe_2O_3) oxides. The more oxygen there is, the more iron can be combined chemically with it, the more rust grows or accumulates.

In the formation of sulphuric acid (H_2SO_4) from sulphurous acid (H_2SO_3) by the accretion of oxygen, the oxygen loses its characteristics, and the amount of H_2SO_4 increases with the oxygen supply from the air.

Similar, but much more complicated, is the growth of the 'Pharaoh's serpents' so well known alike to children and adults. Sulpho-cyanide of potassium together with a solution of nitric acid on quicksilver, gives a white precipitate, sulpho-cyanide of mercury, which after being mixed with a very weak aqueous solution of gum till of stiff consistency and then mixed with a modicum of potassic nitrate, can be rolled to a pill and ignited, when it rapidly grows into a long serpent of mercuric cyanide and para-cyanogen—two distinct atomic organisms, but not organs; for although accreting, it is not living. The temperature of production is higher than that of now living protoplasm, although the pressure is the same. Experimentalising with these serpents, I have found that intenser heat slightly accelerated the development, whilst intense cold made the motion sluggish. The heat, I produced by growing my serpent on a piece of charcoal enlivened by a blow-pipe, whilst the cold by submerging a thin aluminium cup containing the serpent in another vessel holding a freezing mixture. These experiments go to prove that, along with growth, there can be assimilation and irritability or power of motion by stimuli.

All the foregoing facts lead us to directly contradict Mr. Wilson's baseless assertion:

> "The saying that 'like draws to like' is really and literally true of the growth of non-living nature."[1]

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[1] "Science for All," ed. by Robert Brown, M.A.; vol. ii., p. 205.

Why, even simple forces act differently. Two electric positive currents passing near each other will be mutually repelled, whilst a positive and a negative current will be drawn together. If a pith ball float in a basin of water, it will in time be attracted to the side by the material composing the containing vessel which is not pith. The laws of chemical affinity undeniably prove that 'like' atoms do not attract each other.

Up to this point, we have been considering accretions under normal conditions, or such in which the temperature has been considerably raised. We next come to substances under the influence of great pressure.

Here must be discriminated between those instances in which the accretion is not detrimental to the characteristics of the bodies brought together although the new compound body, as such, may have qualities unshared by its components, and others in which the characteristics are partially or entirely lost or merged in the growing body.

As an example of the first category, may be given the union of the aforesaid ferric and ferrous oxides. Under great pressure, these combine to form magnetic iron ore or loadstone ($FeO,Fe_2O_3=Fe_3O_4$), whose nature it is to attract loosely to it small particles of iron as does an artificial magnet.

As an illustration of the second category, one cannot do better than again place before you the simple case of the snow-ball. If I quickly press the snow-ball very firmly together indeed, I form a hard ice nucleus in the centre of the ball. It is interesting and worth pointing out, that although the outer layers are so to say jammed in between my fingers and the interior layers, it is the interior layers that get hard first. If both be expressed in similar terms of energy, we might say there was more cohesion in the interior than adhesion in the exterior layers. In a molecule of albumen there has been shown to be more stability in the middle than on the circumference.

What takes place with the snow-ball? When we make it, it in the first place increases in size till more pressure is applied. Thereupon occurs a decrease in the size of the entire, but the centre, as such,—and with this alone I now deal,—is being accreted from the outside layers, and strengthens. It accretes, and yet gets smaller. Then the moment arrives, when its entire structure re-forms and assumes the allotropic form of a solid ice mass, despite the warmth of the hands, and it expands, grows. This decreasing, strengthening and

increasing, reminds one forcibly of the opening phases of accretion, *decrescendo* and *crescendo* of the Schubert C symphony which, it will be remembered, was compared to the first growth of a young plant (*vide* p. 188).

A young child has many an illness, and becomes thin while it is growing (there is an actual loss of weight for the first few days after birth), as does a piece of ice weigh less than the water it came from. The ice of a snow-ball, expanding inside, at first presses and thus warms and melts the layer nearest it, whereupon this aqueous layer is then frozen to one piece with the core, and, following our picture, we notice that a human being weighs more, has accreted more at death than was possessed by the new-born child. By somewhat stretching the analogy, we see that the ice core is not in the same crystalline state as the small crystals of snow from which it was formed, or its yet more differentiating allotropic mode, the water drops whence these were derived, and so too a plant, coming from the seed, receives a new construction, a new nature when it arrives at its embryonic stage, which structure is again altered in the mature plant. In the case of the development of the human ovum to man, we find the stages of yolk, cartilage, and bone.

As regards the snow-ball; formation, up to a certain point was slow: then it rapidly increased in speed, and in the end, the final amalgamation was again slow. So also with the child. Not only does it at outset not grow fast, but like the ball, it very suddenly accelerates its speed, owing to the rapid renewing of the blood in the tissues, the circulation taking 12 seconds (frequency of heart-beat 130-140 per minute in the first year). This speed pulsation decreases in the second year to 110 per second and to 90 per second in the tenth year. As of course the size of the body has been increasing, the circuit traversed gets greater, so that in an adult, the circulation takes on an average 22 seconds and there is thus a slower renewal of blood in the tissues, less accretion, and more decay. At first, only the ossicles of the ear are perfectly ossified—have arrived at their final capacity for assimilation and accretion—but ossification of the cartilage sets out at a rapid rate. It too gradually settles down, and complete ossification (assimilation and accretion of bone matter) takes place in the 25th year.

Shall I press the analogy to extremes? I have, let us suppose, all this time been pressing the snow-ball with my warm hands, but on account of the nature of the snow-ball, the heat of my hands, although part of the environment of the same, has not as yet had

any effect on the core, which consolidated under the pressure—another characteristic of the environment. But if I maintain my hot hands on the ball for any length of time, the heat too will exert its own, and, whilst the pressure will tend to cause the whole to crumble, it will cause the same to melt. Death to the snow-ball came under the same external conditions as were there at its birth, and its parts returned whence they came. Most likely my handiwork could have been done by machinery.

I have only been making use of these comparisons between the stalactite, Pharaoh's serpent, the snow-ball and the like more inorganic processes on the one hand, with living organism on the other, as illustrations of the similarity of functions in the two masses as a sort of set off against Mr. Wilson, who says:—

> "There was no growth or expansion of one crystal into many[1] . . . In the plant on the other hand, we saw that the 'seed' containing the 'embryo,' or young plant, by a process of *development* produced the new being. The crystal grew by mere addition; but in the plant there was seen the production of new and varied organs[2] from parts and structures which were first of similar nature.[3] Internal *development*, not outside addition, is clearly the law of living growth."[4]

But, as you see, there is just this one great danger in such like analogies: the forming in one's mind of the crassly absurd conception that length of life, assimilation, development, and even reproduction and the like more are components of growth, and that therefore all such forms of accretion of inorganic matter as I have cited, are not 'growth,' which is a special term applicable only to living organic matter, whereas, of a verity, length of life, assimilation, development, and reproduction are never the integral parts, but merely simultaneous accompanying phenomena of growth (which has yet by me to be defined) and co-components—if I may be allowed thus to express myself—with growth of that bugbear 'vitality.'

After this lengthy excursion, we return afresh to the consideration of a last class of accretions; those taking place under conditions of combined high temperature and high pressure.

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[1] This were reproduction, not growth.

[2] Evolution based on hereditary characteristics. We have found that evolution and heredity can exist independently; here we have a combination.

[3] Assimilation, based on chemical affinities under various physical stresses, together with metamorphosis.

[4] *Vide* art. 'Growth' in "Science for All," vol. ii., p. 204.

In the early geological epochs of the world, the presence

> "of pneumatolic agents—water, alkaline silicates, chlorides, and florides with other vapours or solutions, has been largely influential, combined, doubtless, with great pressure, high temperature, and a continance of these conditions for vast periods of time,"

says Prof. Archibald Geikie,[1] in bringing about what is known as 'contact metamorphism,' or a chemical affinity between particles which would have had, under other conditions, no chemical affinity for each other although existing side by side in the same mass, together with probably a simultaneous allotropic modification in the structure of one or more of them.

As in the snow-ball, so kindly note here the system of accretion which is going on between the pressing forces.[2] The centre of this pressed body of matter, as long as the above conditions of pressure and supply are maintained, is taking several foreign matters, forming them into a new compound of the same nature as itself—it is growing. Although, of course, the surrounding mass is losing, the growing mass is taking its supply (food?) from its environment, matter unlike itself—*i.e.* not yet like it, changed in chemical and physical structure. Under the conditions obtaining, this mass not only absorbs molecules, atoms, or electrons of various substances, elementary or/and compound, but various parts of it themselves combine with these latter to form a similar mass. In other words, this compound body, as such, *i.e.* a substance formed of various ingredients, each with specific characteristics, is being increased by chemical affinities for other stuffs not of its nature.[3] It is receiving matter within the body. When the environment can supply no more of the essential constituents, this body ceases to grow; but it does not, on that account at least, die or break up or decompose.

But then, death is cessation of life—a given specific state of dynamical equilibrium[4] under certain conditions of temperature, pressure and stress, which vary within definite bounds fixed by the nature of the constitution of the living matter—and has primarily

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[1] *Vide* "Text Book of Geology," vol. ii., p. 767, by Prof. Sir Archibald Geikie, F.R.S.

[2] If two forces press between them a third, either both forces can be in like degree active, or the one active, pressing the intermediate body against the second, which offers the force of resistance.

[3] A body may be at one and the same time a chemical compound and a mechanical mixture.

[4] An exact equilibrium is never obtainable. There is ever a constant rising and falling of the balancing moments; there is always one force at odds with its infinite competitors.

nought whatsoever to do with growth or increase of mass (as I showed on pp. 195, 196), although of course an untoward stoppage of growth may be the cause of death to, may kill a living organism. *Growth is by no means synonymous with continuance of life.* How different this is again from the popular writing of the popular writer, Andrew Wilson, who puts it down [1] that:—

> "Life and growth mean one and the same thing; *they are in truth convertible terms* [2] . . . growth and increase are essential facts of life."

An inorganic system can 'grow' and yet be 'dead'; an organic may be alive and yet cease to grow.

The salient point out of my last example seems to be that there is a certain mass under a specified temperature and pressure, which produce given chemical affinities, by the aid of which is it being continuously augmented at the expense of the environment. Analysed, this resolves itself into the simple fact that by means of compelling and attracting forces, be they temperature and pressure (compelling) on the one hand, and chemical affinity (attracting) on the other, there has been an accretion of elementary particles; that is all.

Let us turn our attention to 'living' matter. At this stage, it will be as well to definitely clear up a misconception already hinted at on pp. 197-198. I here therefore advisedly repeat my quotation from Wilson:—

> "Life and growth mean one and the same thing; they are in truth convertible terms . . . growth and increase are essential facts of life."

Now, life is sustained by a combination of anabolic and katabolic processes, but, up to a certain point, there is actually life of the plant and animal body when the degree of katabolism is virtually in excess of the anabolism; *id est* where there is not only no increase, but a decrease.

When a plant has ceased to grow, it fades, but does not at once die. So axiomatic does it appear, that I should have hardly thought it necessary to make the statement:—'a dying animal, one in a state in which katabolism is in the ascendency, is not dead but living.' Why! Every scientist knows that a nerve, when once severed from the body, does not at once die, but it certainly does not grow. "Growth and increase" are not "*essential* facts of life"

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[1] "Science for All," vol. ii., p. 201.

[2] The italics are mine.

in every sense and case, although, as often as not, they are concomitant phenomena.

Take the plunge *in medias res.* A living cell requires, at least in the present state of existence, an inorganic environment; cut off this environment and it dies. That means to say, its development depends on supply, on accretion. There is no single element or compound in a living cell that increases its own bulk.

In an article, 'How Plants Grow,' by Prof. G. Dickie, M.A.,[1] there is the following concise elucidation of the process of 'osmose,' which is very important in the growth of living matter :—

> "When two fluids of different densities—*e.g.* water and syrup—are separated by a thin membrane, whether animal or vegetable, the denser fluid increases in bulk by the passage of the other through the membrane. . . . Take, for instance, the bladder of any small animal, half filled with a solution of sugar, forming a moderately diluted syrup; secure the opening by a string, and place it in a vessel of water. The bladder, after a time, will become full, and may at last burst; this property of such membrane is called 'osmose.' . . . The same result can be seen by dusting a little pollen from a flower into a few drops of water; each grain swells, and finally bursts with some force. Or place them in syrup instead of water, and the effect is reversed—they shrink."

Now, in an earlier part of this work, we saw that when albumen or its living representative protoplasm is formed, it receives a cell-wall[2] from its environment, which is modified by chemical actions. This material is celullose, and acts as a bladder. By the action of osmose, it draws or sucks in water and other substances not of so great a density as the protoplasm. By the combined action of water, protoplasm and these other substances, these last are chemically formed into protoplasm—there is the combined chemical action and accretion. As, most probably, protoplasm is the crystalline condition of a substance under certain temperature and pressure, giving it a consistency between liquid and solid, so can it be assumed that new crystals or cells are formed. These burst the wall and are now independent cells.

> "At the limit of growth cell-division occurs,"[3]

says A. J. Herbertson, and, continues he,[4]

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[1] "Science for All," vol. i., p. 299; pub. Cassell & Co., 1890.

[2] There are some exceptions, as in the cases of certain naked or wallless algæ, but even here, mechanical agency is at work.

[3] This cell-division must not lead us astray. It is a factor of reproduction and not of growth, although it has to be mentioned here.

[4] *Vide* art. 'Vegetable Physiology' in "Chambers' Encyclopædia."

"After a cell has ceased dividing, the mass of its protoplasm is probably not greatly increased, but vacuoles appear in it, and as the cell grows older and elongates the protoplasm finally forms a membrane bounding one large sap vacuole and lining the cell-wall. The protoplasm has been rapidly added to the cell-wall, and at last the wall assumes its final shape and markings. The elongation is due to the distention (*turgor*) of the cell by accumulated water."

Culling from and paraphrasing the above, we see that while accretion is going on in the interior of the cell, the cell-wall has gained in space, but not in bulk; it is only distended or turgescent. When water becomes ice, and most likely too, when crystals form, the particles take up an allotropic formation in which the particles are extended. Since the matter of a cell is not continuous matter, 'distended' is here tantamount to 'extended.'

"When the wall is stretched in this way new cellulose can most readily be added. The cellulose may be deposited as such, or precipitated from some compound the rest of whose constituents are soluble. The unit may be the cellulose molecule or a more complex one formed of an intimate union of several molecules (Miscellæ of Nägeli).

"There are several theories as to the way in which the cellulose in any of the conditions just mentioned may be deposited. It may be plastered on inside of the wall (apposition theory), or the protoplasm may penetrate the cellulose wall and there lay down new matter, or the cellulose may be floated into position between old particles (intussusception)."[1]

Here again, you see the action is purely mechanical, whichever of the above theories be true, and the action is one of accretion. It may not even be necessary, as Wilson would have it, that

"both animal and plant grow by a process the exact opposite of 'accretion' and which we name '*intussusception.*'"[2]

for if it were a fact that protoplasm penetrated the cell-wall and there laid down new matter, this too, as well as intussusception could account for "the transformation of cellulose into wood (lignin) or cork (suber) or gum (mucilage)." But even should intussusception be proved to be a fact, which no doubt it is, the distinction between it and the accretion going on in dead systems is not so clearly defined as one might imagine."

An animal can assimilate a compound, *e.g.* a nitrogeneous carbohydrate *in parte*, and take the carbon for one group of cells, the

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[1] Art. 'Vegetable Physiology' in "Chambers' Encyclopædia."

[2] *Vide* art. 'Growth' in "Science for All," vol. ii., p. 205.

nitrogen for another, the oxygen for a third, and the hydrogen for a fourth, or it can take the compound *in toto*, as when it takes blood (pure or in the form of such compound mixtures as hæmatogen, etc.) to form blood, albumen to replace a deficit in albumen, or meat in the form of extracts, meat wine, to satisfy a want in flesh, and bone meal to construct bone; but in no instance does it, to our knowledge, take one element and turn it into something else previous to accretion, nor does it proceed differently with a compound, otherwise perhaps than by isomeric change which also goes on in the 'dead' world. A crystal is generally a salt and the product of a base, an acid, and water. In growing, it can of course join itself to other crystals (its like) *in toto* and so enhance its bulk, but it can likewise even in simple cases take water from one part of its environment, the base from another, and the acid from a third, *i.e. in parte;* whilst there are complex instances, under certain physical and chemical conditions, in which the base, being a compound, is each time formed afresh from simpler constituents prior to its union with the acid.

The growth of the Jupiter tree, the tree of Saturn, and the dendrite is not so utterly exterior, the arborescent tendencies being distinctly influenced from within; but when we come to a crystal, the product of a base, an acid, and water, called a salt, and find that with an increase in size, there is no change in the exterior faces or the interior planes, that the polarization and refractive indices are maintained, we shall be forced to conclude that there was intussusceptive action—the base, the acid, the water, or components of these, placing themselves between each other. All the basic materials do not compound with the remaining factors and lay themselves on the faces heterogeneously: but in an order between the others and of given amount.

But this is not a matter for theory or of conjecture only, it admits of experimental proof. If on a crystal in a crystallising fluid, brown paper be gummed on to all sides but the one in the body crystallising, it will be found that the gummed paper will burst but yet remain affixed to the surface or the faces of the crystal. After the lapse of several years, a smoke-topaz (brown mountain crystal), growing in Switzerland, has burst a very thin wooden case, which when first placed over it, fitted exactly. The growth was in no wise exterior. The interior construction and nature of the crystal was unaltered, a fact upon which there is no other construction to be put than that the new matter has by degrees been intercalated in the old. Is this not intussusception?

Again, when under given conditions, an isomeric change takes place in dead organic matter, there can be distension or turgor, and into the spaces so formed, new matter can enter.

What I have said of the osmose action of a single cell holds good in the plant, which we have learnt to acknowledge to be a union of cells.

> "The fluid matter in the soil being less dense than that contained in the cells of the root, by the process of *osmose* is taken in, and thus we have the commencing force of circulation of diffusion of sap in the plant."[1]

In the root of a seedling, it will be found that the greatest increment of growth takes place near the tip. This is due to the elongation of the cells owing to osmose action. Naturally, this takes place to a greater extent where there is more moisture and warmth, *i.e.* in a downwards direction. The suction is indeed upwards, but as every action has its reaction, the reaction is in this case downwards, the root is pulled or drawn down. The extension is at the other end, there where the pressure is least, *i.e.* upwards. In the growth downwards gravity may play a part, and it is generally found that the end breaking the soil is bent downwards. Swelling and distending go on also in the crescentic bounding cells of the stomata[2] of a very young leaf, owing to the activities set up by the chlorophyll they contain. Here again, is a chance for accretion in the interstices formed by turgescence.

Herbertson says,—

> "The matter used for the permanent changes we call growth comes from the excess of it elaborated over that used to repair waste, and the energy from the heat given off in respiration."

How many a crystal expends energy in causing its environment, whence it sprang, to further crystallise, and in forming itself, as well as reflecting and deflecting rays impinged on its surface. Despite this, despite wear and tear due to friction and to the action of the atmosphere and other chemical agencies, it amasses bulk, it goes on accreting, and this accretive matter is that in excess "elaborated over that used to repair waste." This slow accretion is still slower than that of our oldest trees, some of which have been computed to have grown for 600-750 years. On the other hand, fungi grow so quickly

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[1] *Vide* art. 'How Plants Grow,' by Prof. Dickie in "Science for All," vol. i., p. 299.

[2] These stomata or leaf-mouths vary in number from one to two dozen—160,000 per square inch: a linden or lime tree leaf has 1,053,000 of them, a lilac leaf 708,750 stomata, and so on.

that there is little time for waste to form, and a Pharaoh's serpent accretes at a yet more rapid rate.

The increase in the bulk of plants and animals is also brought about by reproduction, *i.e.* by an increase in the number of cells due to budding and fission. But it were erroneous to imagine that accretion alone is going on.

> "During life, it (protoplasm) is incessantly disintegrating and combining with the oxygen of the atmosphere, many products of change, chiefly carbonic acid, water, and nitrogeneous waste being evolved."[1]

Thus it is that reïntegration takes place, and the formation of to-day is not always the aggregate of the accretions since, say, a year ago, but much less.

A chemical compound is not perhaps a sufficiently complex system for comparison, and therefore all those who have heretofore sought to compare such with living organisation have been led astray. But if we compare the mechanical making and growth of a snow-ball, where pressure forces one piece of snow between two or more others, or any other yet more highly complex organisation of dead matter with the growth of a living system or organism (system and organism are here synonymous) and forming our deductions, we shall find that *living growth is but a mode of accretion* in a semi-solid body[2] under certain chemical and physical conditions, including temperature and pressure.

Moreover, by a closer study, it will be found that many of the circumstances under which the two are carried on, are very much alike.

A plant or animal assimilates by day and grows by night, or, more exactly, distention goes on by night, and during the day the interstices are filled up. There is assimilation in the leaves before growth, and the sap ascends in the spring, descending in late summer and autumn, after which growth sets in. A Pharaoh's serpent, as I have experimentally shown, grows quicker in the cool. Generally too, crystals grow most in the cold. And lastly, *mirabile dictu*, iron can grow. This is one of the very latest achievements of science. The Franklin Institute has awarded the Elliot Gresson Gold Medal for a new process by which iron can be made to grow, by alternately and repeatedly heating and cooling an iron bar to a 'critical' temperature. A bar, which had been machined on one side, to exhibit its structure and metallic condition, was laid before the American Association (Mechanical Science section). It had been treated as

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[1] *Vide* "Chambers' Encyclopædia," art. 'Animal.'

[2] Compare with footnote [1] to p. 132.

described, and grown to the enormous extent of 46 per cent. in cubicle content, although, to all appearances, the *original texture had been maintained.* This result is a remarkable and valuable one and right worthy of the new century.[1]

The maintenance of a 'dead' system and the life of a 'live' system both end with a withdrawal of the exterior supply. There is no continuity of development of either.

At this point let us make a halt, and take a peep at the surroundings.

The yellow etiolin of a plant

> "stops certain ether waves which transform it into green chlorophyll. The spectrum of chlorophyll shows absorption bands in the red and violet with less marked ones in the yellow. These waves move the molecules of plastic matter (protoplasm, solids, and solutions) associated with this chlorophyll, so that carbonic dioxide is taken up and oxygen is ultimately set free."[2]

Assimilation of carbon means at the same time an accretion of carbon which has been brought about by purely mechanical means.

> "The increase in transpiration[3] when a green plant is in the light is probably due to all the energy arrested by the chlorophyll not being spent in assimilation but in part vaporising; . . . . M. van Tieghem has termed the transpiration which is a function of chlorophyllic activity, *chlorovaporisation.*"

So long as there is free transpiration, there is little or no turgescence which therefore takes place at night. The filling up with new material goes on by day. This is one reason for the slower increase in the size of plants growing in an artificially produced day-light (electric light at night) of twenty-four hours. The cells not being so turgescent, burst sooner, and hence the greater reproduction. Disintegration goes on in fact to such a great extent, aided too by increased assimilation, and the cells remaining are so small, that sufficient new material cannot enter to form an excess of matter "elaborated over that used to repair waste"[4] and the plants therefore weaken, and seedlings sown, grown, and resown, at length cease

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[1] An interesting explanation of this growth of iron is given by W. F. Badgley in "Knowledge" for March, 1906, pp. 382-383. I have however had no time to go into the merits or demerits of this view.

[2] "Chambers' Encyclopædia," art. 'Vegetable Physiology,' p. 439.

[3] Transpiration or evaporation produced by heat is comparatively small in degree, and is not to be confounded with 'perspiration' which is an exudation of the superabundant moisture of a plant. Thus a flower 3½ ft. high exudes 5·616 cubic inches in every twelve hours, wheat, beans, peas, and clover exude after a five months' growth 200 times their weight in water, whilst the Cornelian Cherry exudes twice the weight of the shrub every twenty-four hours.

[4] *Vide* p. 202.

to grow at all. In greenless plants (fungi) there is less transpiration, owing to the absence of chlorophyll. Now water is necessary to assimilation; but what is here of more importance, inhibition of transpiration is an aid to turgescence.[1] Added to this, fungi grow in the cool and shade, which yet further enhances inhibition. This is, I believe, the cause of the accelerated growth of fungi.

In tropical plants in a humid environment, there is little evaporation or transpiration, owing to an atmosphere already saturated or even surcharged with moisture, hence vegetation's luxuriant growth in such neighbourhoods.

Activity in a plant depends in part on the temperature. To explain the following, it will facilitate matters to reverse the case, by stating that a relationship exists between the amount of energy exerted by a plant (assimilative powers, etc.,) and the temperature in which it grows; the greater the activity, the hotter the surroundings, the less the activity, the cooler the climate. If a plant, in which the assimilation is very rapid, *i.e.* which develops a greater amount of heat, be brought into a cold atmosphere it, like an animal, takes a chill, and dies. Gradual acclimatisation of tropical plants is a gradual slowing down in the speed with which they assimilate, decompose and reproduce and so on. The functions of a palm grown in North Europe, except perhaps in the hothouse, are not so rapid as those of one growing in the tropics. Yet the plant's activities being naturally great, its transpiratory powers are not sufficiently minimised to keep up the degree of growth, much less to accelerate it; for the organisation has not in so short a span of time, adapted itself to the new environment; the palm, if grown in North Europe is smaller than in the land of its nativity.

A supply of alcohol, in a warm climate, to plant or animal has a fivefold and uneven action. Several of these are even apparently contradictory. The alcohol generates heat by oxydation. The heat is so rapidly evolved, that owing to the thus produced sudden transpiration, the walls of some cells are unduly stretched, attenuated and rent asunder, a second group of cells, though not bursting, are made turgescent at such an accelerated speed (which is enhanced by a greater volatility) that cell after cell remains empty or porous, assimilation not having been able to supply and fill up the voids at the same increased rate, resulting in weak cells, whilst these very processes draw away the water from a third group of cells or causes

[1] A plant gets 'wilted' on hot days, more water having been given off and sucked up. After artificial aid, watering, can prolong growth.

a slight increase of transpiration over the water supply causing wilting and deficiency of turgescence. In a fourth batch of cells, the velocity or rate of assimilation is so great as to cause an overcharge in the space available for the reception of accreted matter, causing clogging or premature bursting; and lastly, in a fifth lot, the heat engendered tends to coagulate the albumen. To a great extent, the answer to the question as to which effect will be produced in any given cell or group of cells, is determined by the position or situation which such cell or group takes up in plant or animal. All five effects, however, have the ulterior effect of decreasing the rate of growth and stunting the living organism. In very cold climates, alcohol has a reverse effect and aids growth. A cold organism in a colder climate absorbs very little water, and what there is of it has a tendency to freeze. It is a fact, that living matter of the present day consists chiefly of water. Alcohol warms, prevents freezing by the warmth it produces as well as by its greater volatility, and helps to maintain life by supplying (pumping up) the necessary water still deficient.

I purposely gave an example of an inorganic growth-system developing under high temperature, for the sake of analogy with probable life-conditions going on at high temperatures in the past on our globe and at present in the worlds gyrating round about us; for, as we shall, on thinking the matter quietly over, see, even that is not so preposterous a suggestion as one might at first imagine. Of course, if so it were and be, a living structure would naturally possess quite another basis than that now obtaining; but accretion or growth would be carried on, on nearly similar principles, and accretion would probably be supported in a structure in a too cold (relatively only to greater heat) region with the assistance of methods in most respects alike, although the substances employed would be different. In the earth's early days pressure was most likely less and temperature greater.

Be this as it may, this gives us a clue to another reason for a decrease of growth on transplanting exotic plants to temperate climes. A plant, at the present day, in a torrid zone, on account of centrifugal force, warm air rising, and other considerations, stands under less pressure than one in the temperate zone. If the former, by its organisation, is able to accrete with ease in its native clime, it stands to reason that it is of such mobile character, that, transplanted to less hospitable lands further north, it is under over-pressure, its activities are mechanically suppressed, and it ceases to grow.

And now a few words in conclusion. Increase in the size of living organisms is dependent on growth and reproduction: and we have here momentarily only to do with the former. Fission and budding in simple or complex organisms increases size but it is not growth; it is reproduction, as is birth in the higher grades of life. Animals and plants are said to 'grow' either by (*a*) a combined action: a distension of their cell walls, and new matter entering into the interstices so formed of these, either with or without the new matter having been chemically modified prior to its insertion—a process known as 'intussusception' (in itself purely mechanical)—or (*β*) by the simpler accretive process of protoplasm penetrating the cellulose wall and there laying down new matter. This latter method can be seen any day and everywhere just as often in inorganic as in organic nature. The former—intussusception—has also been shown to exist in the more complex inorganic systems.

Why! millions, perhaps billions of years ago:—

"With speed" those forces[1] "whirled and twirled, and eddied round and round;
And through unknown infinity vibrated the first sound."[2]

Electrons formed, and out of these the gases, and hot flames shot forth their huge lurid tongues into the realms of space.

"Awhile these fretted, fumed, and roared; and whirled and twirled about
Until two gases compact made to put this fire out;
For Combustion's Supporter,[3] and the Heat-giver[4] too,
With a flash joined together,[5] hiding all else from view.

Then the Earth raised her rocks;—she was eager for fame—
And the Water strove with her to win him a name.
And the Earth and the Water did wage a big war;
Until both of them, wearied, declared it a draw.
It was soon after this, that the Water with Earth
Did join in embrace: to living beings gave birth.
Fish and beast, reptile and fowl,
Came forth breathing from Earth's bowel."

And even now meteorites from far off systems are showered down in great quantities and interspersed over our globe; nitrogen and oxygen from our own system are being constantly drawn into our terrestrial sphere. The ærolites and meteorites sink into the earth,

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[1] I have here substituted the word 'forces' for 'atoms.'

[2] *Vide* my poem, verse 5, on p. 70.

[3] Oxygen.

[4] Hydrogen.

[5] Formed water.

break up into their components, owing chiefly to corrosive and oxydising influences, and are, as such, no longer existent.

But these components go to form different parts of the earth, many in mechanical mixture, some in solution, some in chemical combination. Very few, if any, remain for any length (geologically) of time unabsorbed in some one or otherwise by their environment, *i.e.* become accretions pure and simple. Parts go into water, parts to rocks, to minerals, to stones, to crystals. A part, may be, find their way into living organisms. The nitrogen goes chiefly, though not entirely, to the living world, the oxygen oxydises alike organic and inorganic, living and dead matter, and thus forces itself between the particles of other substances.

Where is here merely addition from the outside? Is there not interaction of all bodies however large, however small? Are not the elements intertwisted with each other, their tiny electronic gyrating spheres as well as their larger atoms, their yet larger molecules and their compounds? Are not the waters intercurrent throughout the earthen mass? Are not these interfluent waters a factor of geological metamorphosis? Are not certain geological layers forcibly interstratified with others? The affix '*inter*' is appliable to all words or expressions representing functions regarding our earth's growth since its appearance in space. Sir John Herschell's 5,852,000,000,000,000,000,000 tons[1] have been brought together by a combined system of accretion pure and simple and intussusception. That the earth grew in the past is therefore beyond dispute. Whether or no the world has actually grown latterly is a difficult point to settle, since it has been said by savants, who ought to know, that the earth does not only receive but also ejects mass, and then again, we have learnt of radiating matter.

Only then when a body gains more than it loses, can it be truly said to grow. Thus, if in a body of, say, five parts, there be by the process of intussusception the gain of one part whilst by decomposition there be a loss of two parts, there cannot, properly speaking, be any idea of growth, for **growth is increase by intussusception.** Whether this be the case with our globe, we do not at present know. But this much we can say, the solar system, aye more, the entire aggregate of all the solar and stellar systems with all interstellary adjuncts, as known to us, have grown out of their environment, have grown, like the animal and vegetable kingdom out of the original or

[1] One of the best estimates of the earth's weight.

prime forces (or, more exactly, modes of the one force), by all forms of accretion including intussusception.

And the factors of growth, as found in the live world, can be found in the same interaction in the dead. These are, alternate light and darkness, heat and cold, and pressure, and chemical affinity.

Oh how beautiful is this unity of the universal system!

The visible universe has grown.

Can we take a last peep along the vista of years to come?

The universe will probably die. As we have seen the atom breaking up, so too, will some time or other most likely, suns and planets and stars and satellites break up into the individual force-forms whence they sprang. But nebulæ are forming, nebulæ are growing. There is a coming into being and a going out of existence of inorganic matter in space continuing for eons of years to come. But physical force—chemical force is but one phase of the physical—that gave birth to matter, is itself to matter, an inexhaustible environment, wherefore there can be no finite end to growth as far as supply is concerned. The deciding factor is reproduction. Whether force will infinitely produce matter or take some other mode of action will ever be beyond the ken of the ordinary man, can never be more than a subject for speculation only. No conception can hereof be formed. Man's intelligence cannot help him. Perhaps there will be a time

> "when the grinders shall fail because they have little to do, and those that look out of the windows be darkened,"

a time when

> "desire shall fail: because man goeth to his long home, and the mourners go about the streets."[1]

The men of such last days may know—men, perhaps not as we, with an organism of water, but with a system of alcohol. Yet even they would hardly know what will ultimately become of matter when life is no more.

But I must not anticipate. Let me close with the poet Edmund Spenser:

> "Proud Change (not pleased in mortall things
> Beneath the Moone to raigne)
> Pretends as well of Gods as Men
> To be the Soveraine."[2]

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[1] The Bible: Ecclesiastes xii. 3, 5.

[2] The motto to Edmund Spenser's "Mutuabilitie," forming part of his "The Faerie Queene." *Vide* "Works of Edmund Spenser," p. 423; 'Globe Edition,' Macmillan & Co., London, 1890.

(4) AND (5) SECRETION AND EXCRETION.

There are so many points of semblance between the groups of phenomena known under the all-comprising term 'secretion' and those under the heading 'excretion,' so many allied actions, and even a few repetitions, that in essaying any accurate survey of the province beneath the regime of the one, it is impossible, at certain tangential points, or where lines of enquiry actually decussate each other, not to tread on ground properly subordinate to the jurisdiction of the other. All that can be done, shall be done to inspect each separately; but the two will ultimately here have to be reviewed together.

Prof. C. F. Hodge (Clark University) in Prof. J. M. Baldwin's "Dictionary of Philosophy" describes secretion as

> "The elaboration and separation of substances by glandular cells, or that elaborated, etc.,"

and continues:

> "Those that are injurious and must be removed from the body are termed excretions."

I will tackle Prof. Hodge's last phrase first.

According to him, what is good for the body is kept in (the secretion), and what is bad is forced out (the excretion). This is, to my mind, rather a beating about the bush, for it is by no means proven that substances are expelled from the body *on account or because of* their baneful influence on the system.

The facts can be better expressed by the statement, that the live body remains in existence because all obnoxious matters—those deleterious to life—are, by virtue of its nature and organism, ejected from it.

An analogy can easily be found in the laboratory.

In the saponification of the rather complicated ethereal salts known as fats, *i.e.* when boiling these with caustic soda at normal pressure, the alkali salts of the acids are formed, and alcohol is thrown out. Alcohol is derogatory to the existence of soaps, and the soap only exists as such as long as alcohol is absent. There is no proof *primâ facie* that when first fats were boiled with caustic soda, that this was purposely done to produce soap.

This process may have been one of chance, the two substances, fat and caustic soda, coming together in a great heat; or simply undertaken for the sake of boiling the two without any ulterior intention either of producing soap or of expelling alcohol. Thus, even the excretion of the alcohol was not accomplished for the benefit

of the existence of soap; but in the coming into existence thereof, alcohol, which is derogatory to the existence of soap, was ejected (excreted).

One has to be very careful of one's phraseology; but I think it, for the moment, fairly safe to say that the life of a body is the result of the condition of its being; but this is not granting that these conditions of being were brought into existence to maintain life, even although that is the purpose they serve.

I can conceive of the purpose or use of anything, although it may not originally have been made for or placed there for that purpose. Everything can have its purpose or use without it being purposed. Our conception of the useful is based on our experience of that which tends to make all around us agreeable, and therefore to our minds beneficial to ourselves or to others. Thus, the conception of usefulness is purely relative and based on individual experience.

I find, for instance, that a secretion serves a purpose, has a use,—that of helping to maintain life—but I have no indication whatever, either that the conditions of secretion were brought into existence in order that a body might live, or that the body itself secreted that it might live.

Moreover, if secretion were brought about for a definite purpose in the body, it would be definitely regulated to fulfil its purpose. This is not however the case. *E.g.* the sebaceous glands of the skin, normally, pour their fatty secretions into the hair follicles,—they excrete. It is not only the fact that these given substances are secreted, which is of any economical value; but the further fact, that they arrive by some means in the hair-follicles *viâ* ducts from the mouths of the sebaceous glands a short way off. The secretion, which in this instance is made up of the degenerated and disintegrated cells which line their interior, can be increased by high temperature (due to extra sexual energy) without there being any opportunity for expending it. Owing to this and the driving off of moisture, etc., over-production and accumulation or coagulation may take place, which produces a skin disease known as acne. The hair-follicles can therefore get too much or too little fatty substance. These glands then, with their secretions, are not only useful in the maintenance of life, they can in a small way serve the purpose of destroying it. *The excretive action is here more useful than the secretive.*

Just as often do I hear it said that, as animals become adapted to their environment, and as food is a part of that environment, they

must adapt themselves to the food: hence their teeth become formed for the mastication of that food which is best for them. This is probably only a correct statement within given limits. I can conceive of other constitutional changes going on in an animal so rapidly, as the result of environmental influence, that the food would have to be changed before a sufficient alteration in the masticating adjustment could have taken place. In such a case, the animals would not get teeth to suit the food; but, in evolving, choose as food that which suited their present construction.

So also, the meconium of infants (prior to birth) consists in the main of biliary matter. Bile was not originally there for the digestion, but happens to come in useful to aid digestion.

Prof. Hodge appears to be wrong in yet another respect. Secretion does not seem to be "a separation of substances by glandular cells." In this connection may be cited, that although bile can be found in very minute quantities in the blood, it is not made in the blood and then separated out by the liver (collection of glandular cells), but must have got there from the liver, where it is formed; just as microscopic globules of fat pass bodily through the epithelial cells in the villi of the intestine into the central lateal of the villi and thence to the blood. It is not the substance separated out or secreted from the blood by glandular cells. What actually takes place is, that the liver forms and then excretes bile, which is then secreted by the gall-bladder. The primary or hepatic cells of the liver decompose the blood of the portal vein, the brown and green colouring matters (biluribin and biliverdin) being decomposition products of hæmoglobin, the colouring matter of the blood.

Pepsin,[1] a constituent of the gastric juice from the central cells of the cardiac glands, is made in the cell, as is also the mucin of the saliva from the pairs of parotid, submaxillary and sublingual glands. The abstraction of fats from the proteids takes place in the cells of the alveoli.

"Blood," says Foster,[2]

> "is the ultimate source of milk, but it becomes milk only through the activity of the cell."

And not only of milk—the secretion of the mammary glands—can this be said; but also of all other secretions: they are not found in the blood, but formed in the cells of glands. A

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[1] This name was originally given by Schwann.

[2] Prof. Foster's "Elementary Physiology," vol. ii., p. 785.

"secretion is eminently the result of the metabolic activity of the secreting cell."[1]

In some glands there are muscular fibres wound round the alveolus, the muscular contraction of which forces the secretion outwards. In other glands, 'protoplasmic' contraction can force the contents into the lumen of the alveolus. This last can be compared to the ejection of undigested material or 'excretion' by an amœba. In a third class of glands, the secretion is formed and then simply flows over (*vide* p. 211). 'Secretion' and 'excretion' become, to a certain degree, interchangeable terms; and the question of when to employ the one and when the other can only be decided by the point of view adopted in each special case.

Thus, bile is secreted by the liver, excreted to the gall-bladder which secretes it till such time as it is used for digestion. Parts of the bile, not used in digestion, are excreted. It is this excreted bile which accumulates in the intestines and forms the greenish meconium in the embryo (*vide* p. 212).

Now I am afraid that, being partially led away by the wording of Prof. Hodge's definition of secretion, it has been forgotten that plants too, can secrete and excrete. The resins, balsams, and gums as also the essential oils are good examples.[2]

A secretion can become an excretion by

(*a*) the original secretion being forced out either
  (*α*) by mechanical agency or by an
  (*β*) overflow of surplus material; or

(*b*) what comes to the same thing, the resistance on one side of the gradually amassing secretion is lessened, whilst the increase of matter represents the continued pressure on the other.

(*c*) exterior pressure.

Ransacking this time the vegetable kingdom for our examples; we come across, as typical cases of (*a*) the Frankincenses: olibanum —the lebonah of the Hebrews—which is a spontaneous exudation from the *Boswellia Cartari*, Tacamahaca (almaceja, caricarilo, etc.) and Mayeti, as also copal, gum arabic (from the *Acacia Senegal*) and so on; as examples of (*b*) most of the turpentines (resin dissolved in turpentine oil) such as that which flows from wounds in the trunk and branches of *Picea excelsa Link* and other coniferæ and the

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[1] Prof. Foster's "Elementary Physiology," vol. ii., p. 785.

[2] Not to be confused with these are milk saps or such a matter as tragacanth (gum bassorin from the plant *Astralagus*) which is rudimentary tissue—a gummy mass having the structure of pith, comparable to the early origin of bone.

turpentine tree (*Pistachio terebinthus*), or gum gamboge—a colouring matter from *Garcina Morella* and *Vismia guianensis* gained by incisions—and gum ammoniacum (from *Dorema ammoniacum*) that flows on the slight puncture of a beetle. The wound, incision, or puncture here releases the secretion, the resistance of the bark having been overcome. As an instance of (*c*) may be mentioned the 'dew' exuded along the edge of a 'Lady's Mantle' or other leaf. This is caused by exterior 'root-pressure.'[1] There are cases of combined cause, as in the perspiration of plants (*vide* foot-note[3] to p. 204). Here there is the double action of (*a*) of the overflowing of surplus moisture and of (*c*) the exterior action of heat (*vide* p. 213).

After drinking 'not wisely but too well,' urine is discharged (excreted) by dilation of the renal vessels, thus throwing the 'poisoned' blood into the glomeruli,[2] causing an excessive passing of water. Passage of the fæces is an act of excretion aided by peristalsis. This movement is to be found along the entire length of the alimentary canal from the beginning of the esophagus to the anus as also in the ureters, the Fallopian tubes, etc. Urea, under conditions of moderate drinking, stimulates the epithelium of the tubules to secretory activity. Glycogen [$(C_6H_{10}O_5)\,x$] is produced in the liver by carbohydrates, fats, and proteids; but, as has been proved by experiments with summer and winter frogs, the production is greatly influenced by temperature. Heat from the soil aids the perspiration of plants, *i.e.* the exudation of the superabundant moisture (*vide* foot-note[3] on p. 204).

In nervous affections, the sudoriparous or sweat glands of the skin, of which Krause tells us that there are 2,800 per square inch in the palm of the hand alone, exude coloured excretions, such as blue, yellow and bloody sweats.

Besides pepsin, an important constituent of the gastric juice is hydrochloric acid (HCl), which is secreted by the parietal cells which lie between the central or principal polyhedral cells and the basement membrane of the tubules of the cardiac glands. This acid secretion, which is in the gastric juice in

man	in the	proportion of	0·2	per 1,000
sheep	,,	,,	1·234	,,
dog	,,	,,	3·05	,,

[1] For an explanation of 'root-pressure *vide* art. 'Vegetable Physiology' in "Chambers' Encyclopædia," p. 440, under the heading 'Movements of Water.'

[2] *Vide* Glomeruler mechanism in Foster's "Elementary Physiology," vol. ii., pp. 675-676.

is, according to Halliburton,[1] formed by the action of lactic acid on salt (NaCl) giving sodium lactate and hydrochloric acid; the presence of the lactic acid being accounted for by the action of ferments of the carbohydrates taken at a meal. The formation of lactic acid, when there are no carbohydrates in the food, is put down by Landwehr[1] to the presence of animal gum. Now I think that animal gum could hardly account for the comparatively large amount of hydrochloric acid produced in a dog eating chiefly or only meat, and beg to submit that part of the action may be gaseous and formed by hydrogen on formic acid,[2] producing methylamine (corresponding to amides in plants), which again with monochloracetic acid gives hydrochloric acid.[3] The free hydrogen could be explained by the chlorine of salt (NaCl) acting on acetic acid to produce the monochloracetic acid.

It should be noted that the 'secretion' of hydrochloric acid has been spoken of, *i.e.* its formation in the cells. It cannot form part of the gastric juice until there has been the stimulation due to food or otherwise. There is a more copious flow of bile after food, *i.e.* after extrinsic stimuli. An alkali can excite the gastric juice. So can the mere sight or smell of food. Fright can accelerate sweating. We saw on p. 214 that heat influenced the perspiration or exudation of plants. MM. Charabat and Hebert have given us the results of some very interesting experiments on basil plants:

> "One set of plants were kept in the dark for six weeks and another set under normal conditions for the same period. The amounts of essential oils (to which the perfume is due) were determined before and after the experiments, and it was found that they had increased twenty-fold in the plants kept under ordinary conditions, while there was a notable decrease in the case of the plants in the dark:"[4]

light therefore has also an influence on secretion. Lastly, saliva can be excreted by an exertion of the will.

This miscellany of bare facts in the above paragraph has been brought together for the purpose of showing that in the processes of

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[1] Halliburton's "Chemical Physiology," p. 636, "Chem. Centralbl.", p. 484, and "Pfluger's Archiv", xl. 21.

[2] Formic acid, I believe, forms no unimportant functions, and its action with hydrogen seems a continuation of the formation of formic aldehyde in plants prior to the formation of starch (*vide* art. 'Veg. Physiology' in "Chambers' Encyclopædia," p. 440) by the metabolic action of water and carbon dioxide. When I say a continuation, I mean that it fits into the circular interchange delineated on p. 127.

[3] Prof. Roscoe's "Lessons in Elementary Chemistry," p. 320; pub. London, Macmillan & Co., 1882.

[4] "Knowledge" for July, 1905; art. 'The Consumption of Odoriferous Constituents by Plants.'

secretion and excretion there are, in different cases different forces at work. In the case of urea (*vide* p. 214), the same can, according to the degree of the exterior stimulation, be either secretion or excretion.

The typical secreting gland is a conglomeration of secreting cells $\frac{1}{2500}$—$\frac{1}{1000}$ inch in diameter, bound by a membrane and surrounded by a network of blood vessels. Within the cell, chemical action is going on. Granules form in them and the granules pass or get discharged into the lumen of the alveolus. The cell distends, but soon gets destroyed to form new granules. The phase of growth and destruction has, I believe, been sufficiently studied under the heading 'Growth.' During the secretion, the granules disappear and form part of the secretion of the glands. It seems feasible that endosmosis is an important factor of secretion, and exosmosis of excretion. There may even, in some cases of secretion, be a combined endosmotic and exosmotic action, such as probably goes on in embryonic life in the thymus glands, the purpose it serves being apparently not only the alteration of cellular structure in the blood, but to supply nerve fluid.

Some excretions are ejected secretions, others again are simply ejected products of decomposition. Very many of the secretions and the excretions of both the animal and the vegetable kingdom can be synthetically set up, whilst we know the chemical formulæ of many more. But the question we have yet to answer is: "Can dead matter secrete?"

Secretion requires a receiver to contain the secretion, and I suppose therefore, that in the absence of such receiver or containing vessel there can be no secretion proper. Yet the actions that take place to form a secreting fluid can for the most part find their counterpart in the laboratory. If however, we are allowed (as is most decidedly perfectly legitimate) to include the apparatus employed in our experiments as a part of the analogy, there is little doubt in my mind that secretion does go on in dead mass. The only apparent difference will be that, whereas the animal body continues not only for hours and days but for years to secrete, the laboratory process is soon at an end. Even this difference is only imaginary, for, on the one hand, a continued supply of chemicals would lengthen the duration of action, whilst the living cell also depends on supply (environmental) for continued action, and actually in the living body the functions are not carried out continuously by the same cells which decompose and break up, but by others which

take their place. This borders on the domains of 'reproduction,' with which however we are momentarily not concerned.

Temperature of course makes a great difference in operations. In the animal body, this is seen in the cases of fever, where substances are found in the blood, in urine, in sweat and so on, which are normally absent from these substances. In the inorganic world, one finds the same in the manufacture of carbonate of soda. After the reaction represented by $Na_2S + CaCO_3 = CaS + Na_2CO_3$ has taken place, the so-called 'black-ash' is broken up and lixiviated with warm water. The solution is then evaporated to dryness, leaving 'soda-ash.' Should however water above 43°C. be employed, calcic sulphohydrate (CaH_2S_2) is formed.

In the animal body, quantity is influenced by heat, as in the already cited instance of bile. Similar conditions obtain in the laboratory. A neutral solution of $MgO + K_2CO_3$ or $Na_2CO_3 = 4(MgO, CO_2 + MgOHO + x\text{aq.})$ $[4MgCO_3MgH_2O_2 + xH_2O]$. Hence $\frac{1}{5}$ of the carbonic acid of the decomposed alkalinic carbonate is liberated and combines with a portion of the magnesium carbonate to form bicarbonate which remains in solution. On heating to boiling point, separation is promoted: there is an increased expulsion (excretion) of carbonic acid, and an increased deposit (secretion) of $MgO, CO_2 + 3\text{aq.}$ ($MgCO_3 + 3H_2O$).

Decomposition products can prevent secretion. If one assume NH_4Cl to be the decomposition product of a more complex compound, NH_4Cl can prevent the aforesaid precipitation of $MgCO_3$.

It was moreover shown that the disease of acne was brought about by the collection and coagulation of the secretion of the sebaceous glands (*vide* p. 211). Many substances in the organic world —the proteids—coagulate on heating; but even in the inorganic there are instances, such as that of pure silicic acid (H_4SiO_4). If warmed, and the water is driven off till the solution has risen to a density of 14 per cent., the entire will become a clear jelly-like mass.

Examples have been given of a variation of product due to heat, as also of an increased amount of deposit produced by the same agency. A combination of these, *i.e.* an increased amount of substance, combined at the same time with a variation of product due to change of temperature is to be found in the well-known formation of nitric acid. By heating together at a lower temperature $KNO_3 + H_2SO_4$ we obtain $HKSO_4 + HNO_3$ and at a higher temperature $2KNO_3 + H_2SO_4 = K_2SO_4 + 2HNO_3$; that is to say in the former we get $HKSO_4$ and in the latter K_2SO_4 with an acceleration in

reaction. A similar reaction is that of the formation of $NaHSO_4$ or Na_2SO_4 in the manufacture of HCl from $NaCl + H_2SO_4$.

This latter also represents the first process in the formation of Na_2CO_3. When we were collecting HCl, HCl was the secretion, but if *vice versâ* we desire to collect Na_2SO_4, this becomes the secretion and HCl the waste product or excretion.

Heat may even be an agent in secretion. Thus, *e.g.* I may take a vessel containing some decomposing matter. Into this, by heat, I distil another liquid. Heat here excretes the distilled matter which is again secreted in the vessel containing the products of decomposition with which it may or may not enter into combination. Secretion under the influence of heat also goes on when, in the electric incandescent lamp manufacture, the carbon filament is fastened to the platinum wire. This is accomplished by immersing the carbon-platinum joints in benzine and bringing the platinum to a glow with an electric current. The benzine then gives up (excretes) its carbon which is deposited on (secreted on) the joint. Of course the actual secretion of deposited carbon takes place when it is safely lodged in the glass bulb.

In practice, chemicals are often separated by the process of dialysis which

> "depends upon the fact that all crystallisable substances (called crystalloids) can pass in solution through the parchment paper, whilst all gum-like amorphous substances (colloids) such as the gelatinous silicic acid, cannot pass."[1]

If Na_2CO_3 be heated with finely divided quartz, SiO_2 combines with the sodium and some of the oxygen of the carbonate and CO_2 is forcibly excreted. If the fused mass is dissolved in H_2O and HCl added, H_4SiO_4 ($H_2SiO_3 \cdot H_2O$) is formed, part of which remains in solution. To separate the pure silicic acid from the solution, dialysis is employed, HCl and NaCl passing through into water, leaving the clear silicic acid behind. A piece of marble in the water offers no resistance to the dialytic action. If then, the original solution represent the blood, the water and marble-containing vessel can stand for the cell of a gland and, on the HCl entering the water, a reaction, a decomposition takes place, as given by the equation $CaCO_3 + 2HCl = CaCl_2 + H_2O + CO_2$. $CaCl_2$ remains in solution, and together with NaCl forms the final secretion. CO_2 is excreted. To more vividly bring the analogy before you: this series of processes

[1] "Elementary Chemistry," p. 123; by Prof. Henry E. Roscoe; Macmillan & Co., London, 1882.

can have taken place in closed bladders. As CO_2 forms in the water-containing bladder, this latter bursts, and the CO_2 is excreted as waste into space; whilst the solution is caught up by a receiver, just as gall is collected in the gall-bladder. If machinery be constructed[1] to supply water- and marble-containing bladders (which is quite feasible), the entire adjustment depicts the bursting of cells and the employment of new ones.[2] This analogy is close enough for our purposes, but the picture might probably be enhanced and made so-to-say more plastic by the $CaCl_2$ and NaCl being broken up into Ca and Cl_2, Na and Cl respectively, the former after being dried and submitted to the electric current, so that all these constituents can be re-employed, as also the CO_2 which we had allowed to escape. All these could probably be led to combine with the oxygen of the air and with the silicic acid, and the dialytic functions might go on afresh, and in this wise several times repeat the secretive and excretive actions, but I will not press this point.

There can be such a thing as secretion and excretion due to special pressure. An example of this is to be found in the manufacture of electric incandescent light. Cotton-wool is immersed in a solution of $ZnCl_2$ till all its cellulose has been dissolved and the whole attained a consistency of thin golden syrup, whereupon this mixture is sucked into (secreted in) bottles by a vacuum pump, thereby excreting all air and superfluous water. These actions correspond in a rough way with the muscular actions by which the secretions and excretions of the human body are in many instances displaced.

If solutions of a chloride and a silver salt are brought together, a white curdy precipitate of AgCl is the result, which, exposed to light, forms argentous chloride and excretes a small quantity of free HCl which, if collected, becomes a secretion.

It is during digestion that the cell-wall enlarges and granules appear in it. The presence of food is necessary to the production of the gastric juice from the gastric follicles covering the coat of the stomach. The presence of an alkali will excite secretion. The presence even of a piece of clay instead of food has been known to start secretion. If the clay contained any chemically or physically acting (radiating, etc.) properties which induced it, I do not know;

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[1] It may be urged that machinery must be driven, whereas a living body is not. This is misrepresenting facts. Both require external fuel, and even a part of the body is driven by other parts.

[2] Here, of course, we are dependent on reproduction in the living organism; but at present each phase of the life process is being separately treated, so that this last phase therefore need not now trouble us.

but the probability is that the stimulus of contact, aided, may be, by mental[1] activity, usage, and so on, produced an excretive action on the glands, which then poured out their remaining contents into the stomach. But it is a fact, that as soon as the body and mind begin to become conscious of the cheat imposed, the cells or follicles no longer produce gastric juice although there is a continuance in the supply of non-edible matter. A further flow of secretion is then only possible on the presence of digestible substances. This means to say, that the usual chemical reactions are requisite for the production of the gastric juice. An inorganical process for secreting HCl is easily effected by the action of an alkali, if carried out on the lines already laid down by me.[2]

Mention has been made, that fright, sight, scent, and even will[3] can start or augment secretion and excretion. In the case of fright, electricity may most likely act as a decomposing or/and synthetic agent, either directly as an electric current, or indirectly through heat or chemical action and, in the instance of sight, light could perhaps account for the resulting phenomena. But with regard to scent and will as also to the two former, there is little doubt in my mind that, either directly from the brain or *viâ* the ganglia, or from the ganglia direct, there are conscious or sub-conscious muscular, nerve, or other tissue contractions or/and expansions—the nerve again especially being able to provoke proto-plasmic expansion and contraction—and any or all of these are active in collecting or ejecting, secreting or excreting—a purely physico-mechanical interpretation, of course, of the above phenomena.

In the mammary glands, there goes on what is known as absorption: that is to say, the secreted milk is, in the usual course of things, absorbed. That the secretion of milk is more rapid just after birth is easily again simply physico-chemically accounted for, as is also the fact of the swelling of these glands during menstruation. When the glands are fully charged, the first milk can be drawn off after removal of the epithelium. Even when the glands are charged, the milk is, normally, absorbable. Should the absorption be too slow, the milk may get 'poisoned'—decompose—and thus affect the health of the patient. Absorption is however not confined to organic life.

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[1] Here 'mind' is used in the wider sense, including the gangliac functions.

[2] That is, by the inclusion of the vessels, retorts, bladders, etc., employed in the manipulations and reactions.

[3] The saliva can be excreted at will.

In the laboratory, many cloudy precipitations, on long standing, become again absorbed,—are again in solution. This can take place either at normal, or during a rise and fall of temperature. If CO_2 be passed into lime-water, a precipitate of chalk is formed. If the passage of CO_2 be continued, the precipitate disappears, and we get a chalk solution in a pure liquid.

There are still several questions which Prof. Foster has put forward in the shape of problems yet to be solved, which command the attention. Their at present non-solution need not in any way disconcert us, for it would appear, from their nature, that there had been much too little observation on these items, and already guesses as to the answers can be made.

In brief, the mooted points are :—

(*a*) Why does the amœba not dissolve its own protoplasm although it does that of a diatom ?

(*β*) Why does not the pancreatic juice (active in an alkaline medium) not digest the proteids of the pancreas itself ?

(*γ*) Why do the digestive cells of the bloodless actinozoon or hydrozoon not digest themselves ?

(*δ*) Why does the living amœba resist during life the entrance to itself by osmosis of no more water than it actually requires, whilst at death the water enters unrestrained, as proved by the breaking up of the protoplasm and the formation of bullæ ?

Even from the little that has in this work been adumbrated as to the life-history of the amœba, a part-reply to (*a*) can I believe be found. We have seen how slight need probably originally have been the differentiations or/and chemical constitution of protoplasm to produce fertilisation of the sleepy female cell by the lively antics of its ciliated colleague, or the fundamental variations of the earliest members of the vegetable and animal kingdoms.

It was noted, in the first instance, that in all likelihood, the original protoplasm was an isomer of its environment. As such, it had chemical and physical potentialities not shared by the surroundings. It was thus able to act on other bodies differently to this environment, and the environment acted on it. Thus, variations in the constructions, nature, and even slightly in the combining proportion of the constituents of protoplasm were brought about ; and the protoplasm of the diatom is not necessarily exactly the protoplasm of the amœba ; and the latter can therefore dissolve the protoplasm of the former, although the amœba has no power to dissolve its own,—the two protoplasms being actually different.

The degree of concentration or saturation of a substance makes a difference to the ultimate result of a reaction, and we are not even agreed that the digesting fluid of the amœba is the same as that of the diatom. The combination of these two fluids, together with the bubble of water known as a 'food-vacuole,' may be a digestive medium for protoplasm, although the solvent possessed by the amœba alone, may be insufficient for this purpose. The combination may be able to dissolve the protoplasm of the diatom; but incapable of affecting that of the amœba, that of the latter possessing a different condition or/and different constituents and consistency.

Again, the same reagent does not always act in the same way. How a reaction falls out, depends to a great extent on various obtaining conditions. This cannot better be illustrated than by referring the reader to the already for another purpose cited case of the action of CO_2 on lime-water (*vide* p. 221, ¶ 1). Sometimes the CO_2 precipitates chalk and sometimes it does not. It is easy to see therefore, that even if all the chemical constituents of amœba and diatom be the same, the conditions of their being might vary in such wise, that the solvent for the protoplasm of the diatom might yet be no solvent for the protoplasm of the amœba.

The solution to (β) is to be found in the latter portion of my reply to Q. (a).

A part-solution to problem (γ) is also given by the last section of the answer to (a). Another feasible explanation is based on the chemical axiom, that a substance never, under normal conditions, acts on itself. For instance, with the exception of ozone (O_3), (brought about electrically), free oxygen never acts on free oxygen; but when O is in combination, free O or another compound of O can act on it: as in the reaction $2NO+O_2=N_2O_4$. Likewise carbon only acts on a compound of carbon, as $C+CO_2=2CO$, and sulphur on a compound of sulphur, as $FeS+H_2SO_4=FeSO_4+H_2S$. This combining axiom for elements is also true for a compound. Pure water (H_2O) never acts chemically on water, but in combination it does. Thus, $\underset{(C_2H_4\cdot H_2O)}{C_2H_6O} + \underset{(SO_3\cdot H_2O)}{H_2SO_4} = H_2SO_4\cdot H_2O+C_2H_4$. Similarly, NaHO never acts on itself, but $\underset{(C_2H_2O\cdot NaHO)}{NaC_2H_3O_2} + NaHO=Na_2CO_3+CH_4$. The same holds good of yet more complex combinations (either chemical compounds or mechanical mixtures), so that although the digestive cells of the actinozoon can digest foreign and extraneous matter or even

compounds of themselves, they themselves remain intact: they are not Kilkenny cats that eat each other up.

When I say they do not devour themselves or their colleagues of a similar substance, of course I mean that the cells do not do so as long as they are integrities. Do they, however, break into two substances, so does the one substance act on the other within the same cell. As soon as there is an endexoteric reduction in the amount of respiration of a living cell, there is the formation of acid. This acid goes yet more to minimise respiration, and if there be no sufficient exoteric source of recuperation, these processes continue till death sets in. The acid accentuates actions or/and accelerates reactions within the cell and—*the cell digests itself.* When auto-digestion has gone on to such an extent that there be no reaction to external stimuli, there is death.

And the medium in this formation of acid—what is its name, its nature? Is it cyanogen?

It would perhaps have been easier to unravel the present mystery implied in Q (γ), after knowing what life was: but as, at this moment, that is just what we are seeking to understand, the riddle must be guessed in some other way. The solution must however be prefaced by the remark that, although most likely more water does enter after than before the death of the amœba, breaking up of the protoplasm and the formation of bullæ are by no means convincing evidence on this point.

But this much as regards the 'live' condition is, I believe, clear: the state is one of activity and regularity, as are all physical-chemical actions. Nowhere is this seen to better advantage than in the beautiful gyrating wreaths of P_2O_5 which form, on PH_3 coming into contact with the air[1] in the presence of a little vapour of PH_2. These wreaths are always about the same diameter and gyrate at a uniform speed. An activity which is regular, affects all forces within and without with regularity; that is to say as regards time, degree, and amount of force, and so on. The 'contractile vacuoles' pulsate steadily and the contractions and expansions, although in this case taking place in various directions, do so with regularity, and the *pseudopodia* stretch out and extend themselves only within a limit given by the nature of the body—its size, structure, density, consistency, its capability to react on the stimuli of its environment, and its own internal energy—and the digestive

[1] $3CaH_2O_2+6H_2O+2P_4=3[Ca2(PH_2O_2)]+2PH_3$, or by dropping fragments of calcic phosphide into water.

and other chemical actions are timed, so that that assimilated will therefore under normal conditions (the maintenance of the same degree of exterior and interior stimulation) always be the same in quantity. As soon as there is death,[1] there is less action of the amœba *versus* its environment (resistance, etc.), and water mixes with the decomposed parts. This death however, as we shall see later on, only takes place when amœbæ have multiplied too much for a given environment,[2] or conjugation has, in certain instances, been prevented. ~~both of which states, with very few exceptions, are only to be brought about artificially~~.

Whether the hypotheses here presented with all due humility be right or wrong, the problems which they are intended to solve, in no wise influence the fundamental principles of secretion and excretion as they are put forth in this section. These two allied functions can take place alike in organic life—from man downwards, to the amœba that is only able to digest (chemically act on) a part of that round which it flows, letting the residue fall from it—and in the laboratory.

But before closing this section, I desire to call your attention to the fact that there is absolutely no need to resort to the laboratory in quest after examples of secretion and excretion in 'dead mass.'

Long, very long ago, in the old carboniferous period, the living Calamites, Lepidodendra, and Sigillariæ secreted their resins and essential oils; whilst to-day, their dead bodies, the coals in my library fire-grate, are excreting the same as pitch.

But the same thing is going on on a far grander and more gigantic scale all over this globe. Does not the lake near La Brea in Trinidad secrete its pitch? Is not asphalt secreted in France, Dalmatia, Switzerland, and elsewhere? Is not mineral caoutchouc secreted in Derbyshire? Do not the wells of Russia and America secrete petroleum and other mineral oils only to eject them, and the subterranean lakes their waters only again to discharge or excrete them as hot springs in Kissingen, Aix-la-Chapelle,[3] Karlsbad, and elsewhere, or as geysers in Iceland and the United States yellowstone region? Do not the bowels of the earth form and retain their secretion till they are, with mighty violence, excreted at the mouth

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[1] Used here as cessation of the conditions called 'life.'

[2] Even then, by sweating off a sheath or cyst, it can herein patiently await happier days.

[3] Aachen.

of the volcano? And lastly, is not the rain-water, after joining the carbonic dioxide of the air and forming hydric carbonate, passed through chalk-lime ducts, sometimes sucked through porous earth[1] and secreted until such time as it is excreted as chalk-laden spring-water, hurried along ducts termed river-beds, till it is again secreted in the bed of the ocean, prior to its re-appearance in the clouds?

(6) Reproduction.

I cannot begin this last section better than by re-quoting Prof. Hodge:—[2]

> "Reproduction: the power of changing dead (food) matter into itself, thus reproducing itself and increasing in amount up to the limit of the food supply. All known living matter has thus arisen from previous living matter."

The reader is now in a position to see that Prof. Hodge has put a rather distorted interpretation upon this phase of life, which is, to say the least of it, very misleading to others.

It is true that reproduction has not yet been sufficiently described here to give one a definite conception of its specific character (although this was hinted at as regards the reproduction of sound),[3] nor even to allow one to fully appreciate the place it occupies in the functions of a living organism: but we have the negative knowledge that it cannot be "the power of changing dead 'food' matter into itself." Prof. Hodge evidently confounded 'reproduction' and 'assimilation.'

In the section on 'assimilation,' we learnt that no living cell could change dead material into itself, but that food stuffs were disorganised and partially reconstructed *in another form*. But this is assimilation and not reproduction.

The microphone reconstruction of a sound (*vide* p. 189) is a magnified image of the original. When, however, sound is sent through a telephone, it is broken up at the transmitter, and a similar sound is produced at the receiver. The original sound has been re-produced, for the waves of sound coming out are the same waves that were put in.

In the case of the resonator (*vide* p. 190) there is an increased surface, each part of which is producing similar vibrations to a given note. There has been apparently manifold reproduction? Oh no! Not so is the fact. There have been so and so many fac-similes of

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[1] Natural osmosis. Is digestion going on in the earth's bowels, when vapours superinduce changes in rocks (solfataric action)?

[2] *Vide* p. 175.

[3] *Vide* pp. 189-191.

the sound produced, but they are not reproductions but new sounds, which are, to all intents and purposes, similar to the original sound.

The sound imparted to the telephone is an instance of true or primary reproduction. The example of the resonator is one, which, for want of a better term, I shall call secondary reproduction.

Primary reproduction we never find in organic life, but only in the prime or single forces.

The only exception, if exception it be, were to be found, could it be shown that when a living organism dies and decomposes, or when a compound breaks up into its components, that these very products of decomposition or self-same components, reunited and again formed the living organism and the chemical compound. Thus, if a certain portion of water, by electrolysis, be broken up into its constituent parts H_2 and O, and these gases, without loss, collected and by ignition reconstituted, then were reproduction there. There is, however, always a certain amount of loss or leakage, so that perfect reconstruction can never take place. In this sense, even the above cited telephone example is not one of absolute reproduction, since the waves at the receiver are smaller than at the transmitter.

We meet in living matter with secondary reproduction only,—reproduction in the sense of multiplication—and therefore, when in the following remarks, I, for terseness, refer to reproduction, secondary reproduction must be understood.

Secondary reproduction is the production of *similar* organisms to itself from its surroundings, which organisms are either perfectly independent or attached to the original organism, and it is herein that it differs from assimilation, which is the production of similar material from environmental supply without any arranging of parts to an organism. A cell grows and assimilates till the occurrence of division, when the unsaturated portion is partly separated from the saturated original, and then begins, by virtue of heredity, to assimilate, and to adjust its component parts into the same order as the mother organism. Moreover, assimilation is produced by the decomposition of material, the products of which form chemical combinations with the environment and with each other to form fresh matter similar to the original; whilst reproduction is the continuation of assimilative together with growing power (combined with heredity in some form), after the separation of the

unsaturated from the saturated portion has set in, and which thus leads to the perpetuation of similar organisms, but not of the same organism.

The much vaunted cellular reproduction is not the prime. The cell is not actually reproduced manifold—for this would cover creative force which is impossible—but with the aid of its neighbouring materials, many fac-similes are made of it, each of which has in it a larger or smaller part of the original. The original cell divides, and each part is then nearly similar to the original, but smaller and unmatured; but by growth, assimilation, and heredity, it soon attains the same size as the mother cell.

By heredity, I mean the maintenance of characteristics, the keeping of a character or nature. Thus, if it be in the nature of a piece of matter to be elastic, to distend, and if it also be capable of assimilation, *i.e.* if its products of decomposition are able to unite with the environment to form matter like unto that which existed before decomposition set in, and lastly if it can likewise grow; then if a piece of the original matter be torn off, this piece will, by its natural character, also assimilate, grow, and be elastic or distendable.

The simplest example of the maintenance of characteristics which I can give is that of the already ofttimes cited nitrous acid (N_2O_3) being broken up during the manufacture of sulphuric acid (*vide* p. 149). The nitrous acid, after partial decomposition, re-forms, and the new nitrous acid is capable of the same reactions, has the very same characteristics and nature as the original. This it does by virtue of the fact, that when it breaks up into nitric oxide (N_2O_2) and oxygen, the nitric oxide never loses its power of again combining with oxygen to form nitrous acid. This it will do as long as the conditions are maintained. The character is hereditary and cannot at once be lost. Likewise, when sulphuric acid (H_2SO_4) breaks up in alcohol (*vide* p. 185), and is again rebuilt from the environment, the fresh sulphuric acid possesses all the properties and qualities of the original acid.

You see that heredity is simply maintenance of character. If then, in a certain environment, under given conditions of temperature and pressure, a body breaks up and again rebuilds, *i.e.* is in a state of fermentative motion (the complex action is here chemical affinity for and stimulation by the environment), then as long as the inner and outer conditions are maintained, the fermentative motions will continue. A little drop of sulphuric acid, taken from the main

mass, corrodes or eats into zinc just the same as the entire remainder. So also does a daughter-cell act just the same as a mother-cell. It is inherited character. That a thing, by its nature, does not lose its character till it is forced so to do by environment, is simply stating the well-known law that each force has its full effect till acted on by some other force.

As every force is acted on by some other force, sometimes slowly, sometimes quickly, so is absolute maintenance of character impossible. Alter the environment however little you will, the result is slightly altered by that little. The maintenance of certain conditions at any place is only achieved by altering them at another. Thus the whole is always in a state of change. Although one cell appears exactly similar to another, it has really undergone a small change and this provides us with new types.

As soon as each of the daughter-cells has, by assimilation, growth, and heredity attained to the size of its parent, it too breaks up, and the process goes on anew.

There is never a disintegration of a cell, only later on to have a reintegration of its parts. The parts never come together again: there is never prime reproduction, only secondary. The parts form for themselves, by their nature, true copies of the original.

When the nostoc and rivularia bud, when the Schizogenes multiply by breakage and reproduce by rupture, the same forces are at work, but their actions are more intricate. Most likely too, new groups of forces increase the complication, and so finely are the meshes woven and so complex does the entire become, that only some few of the many functions can be traced to their source.

And the same must be said of all the multicellular organisms up to man. Each cell of the human body breaks up. When it breaks up, it either dies,—the environment utterly destroys its character and decomposes it,—or forms daughter-cells (the environment maintains its parts).

Sexual multiplication has, during thousands or millions of years of change, evolved from budding and fission. This is a most interesting study, and those who would be initiated, cannot do better than to study the splendid work "The Evolution of Sex"[1] by Prof. Patrick Geddes and J. Arthur Thompson.

The influence of a male cell or sperm on the female cell is one of environment. Spermatozoa are environment for the ova.

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[1] Pub. Walter Scott, 24 Warwick Lane, Paternoster Row, 1889.

But the spermatozoa, which we have learnt to know as mechanically (osmotically) propelled bits of protoplasm, cannot generate new life without ova. Therefore *all living matter is not reproductive, cannot of itself reproduce.* An ovum cannot, under normal conditions, reproduce without a spermatozoon. In all the higher[1] multicellular organisms, only the ova or the spermatozoa are normally capable of reproducing permanently, *i.e.* in suchwise as to maintain species. The other cells at length die, and leave no progeny,—are, although live matter, incapable of reproduction.

Abnormally, that is occasionally, other cells can be reproductive. After having reverted to the embryonic type or condition and lost their characteristic tendencies, suitable stimuli can transform the somatic tissue of certain plants into gametogenic tissue. The histologists, Drs. J. Bretland Farmer, F.R.S., J. E. S. Moore, and C. E. Walker have recently shown us[2] that the 'Plimmer's bodies' of malignant growths of animals are the same in nature as are certain normal constituents of reproductive cells of the human subject. The somatic or premaiotic cells return to the embryonic state,[3] as seen by the fact that carcinoma is to be found where cells have undergone physiological atrophy or suffered traumatic irritation. Then they become gametoid or germinal. The sarcomatic structures too, which are composed chiefly of incompletely developed or embryonic cells, have also this tendency to become germinal. There is not therefore so wide a difference between carcinoma and sarcoma as has been supposed. It seems more or less a question of state or stage, the latter being the most advanced from the point of view of becoming germinal, some forms by far exceeding true cancers in rapidity of growth.

This process of becoming gametoid is however a combination of physical environmental influence and chemical decomposition due to the conditions obtaining in the immediate environment.

We have seen that by parthenogenesis, male impregnation is not always necessary. Thus, in *Philodinadæ*, a group of rotifers, whilst the female has two ovaries, a male is unknown. In the remainder of these remarkable little wheel-animalcules, the degenerate sperms never succeed in fertilisation, for they die immediately after im-

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[1] Nearer to man, but not necessarily less important than man nor more important than the lower organisms, for everything is necessary as long as it exists, and it will no longer exist when it is no longer necessary. While it exists, it acts on all indirectly, and indirectly all acts on it.

[2] *Vide* "Proceedings of the Royal Society," May 11th, 1905.

[3] A view not shared by Dr. Farmer and his colleagues.

pregnation.[1] But even in cases where generally a male is necessary, there are exceptions.

Geddes states :—

> "Balfour has also cited a remarkable observation of Greeff, who saw unfertilised ova of the common star-fish developing in ordinary sea water, in a perfectly normal fashion, only more slowly than usual."

Here it would seem that fertilisation by a living spermatozoon or even impregnation of any living matter whatsoever is not always a requisite factor of reproduction in a virgin ovum. But Greeff could not be certain that no living matter other than star-fish sperm, did not enter into the unfertilised ovæ. The likelihood is that 'dead' and not 'living' mass caused the reproduction, for the conditions set up by the impregnation by a male,—over-growth in combination with rupture of the unsaturated over-grown parts—has actually been brought about by inorganic matter acting on the live ovum. Prof. Loeb found [2] that if unfructified ova of sea-urchins be immersed for a little while in water to which a small but given quantity of manganic chloride ($MnCl_3$) had been added, and then removed to common sea-water, free from living matter, *that perfectly similar actions and reactions took place to those which would be obtained by regular conjugation. Moreover, the general resultant was the 'artificial'* (?) *reproduction of normal living embryos.*

I must here seize the opportunity to emphasise the fact that without the $MnCl_3$ or the presence of sea-urchin spermatozoa as environment, the animal itself is perfectly incapable of reproducing sea-urchins. There is no doubt that environment is responsible for reproduction. There is no life mystery.

In the plant Lesser Celandine (*Ranunculus ficaria*) indeed, much of the multiplication

> "is carried out by means of the small tubers which are to be found thickly clustered round the root stock. Some authorities go so far as to say that the Lesser Celandine only very rarely produces fertile seed. Numerous other kinds of plants are also able to propagate their kind by root increase, runners, and suchlike methods. But, as any florist is only too well aware, these processes are only really extensions of the original parent, for new *individuals* we must look to the seed." [3]

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[1] Were it perhaps probable that here one or more of the products of decomposition of sperms act as fertilising agent?

[2] 'Studies in General Physiology,' by Jacques Loeb; pub. Fisher Unwin, London, 1905.

[3] *Vide* 'The Evolution of the Flower,' by S. Leonard Bastin, in "Knowledge" for Jan., 1906, p. 321.

In how far Mr. Bastin is right as regards his definition of individuals we shall have an opportunity of discussing in another chapter.

The reproduction of the celandine is not to be confused with adventitious roots as seen in the banyan tree (*Ficus Indica*), the Canary laurel, or the mangrove (*Rhizophora*), or on rose and willow cuttings and so on which are not reproducing but assimilation-assisting agencies. There are not many individual Lesser Celandines, and each new individual comes from a seed.

The cells at the joints of a crab's leg, and parts of worms, have the capacity of re-forming a crab's leg and worm extremities, thanks to the nature by which they, in the presence of a given environment, under certain conditions, hereditarily set themselves in the same order and pass through the same processes. The cast-off arm of a star-fish reproduces the whole. Some worms (*Nemerteans*) break into pieces, and the parts grow to wholes. The same is true of large pieces of sea-anemone or sponge.

In these last instances there is no sign of the evolution of parts whatsoever. The hereditary characteristics are alone sufficient to produce the order of organism. The system is a very advanced state of renovation as seen in the inorganic renovation of N_2O_3 (*vide* pp. 149 and 185, as also 227).

As not always do parts of an organism evolve from other parts, but form independently, so can one picture to oneself some faint idea, that organs may, in the far-off future, be put together in the laboratory. These statements do not go to disprove the existence of evolution, but merely enunciate the simple fact that the construction of organisms is not dependent on evolution.

The hydra can reproduce by gemmation, *i.e.* mouth and tentacles are formed at the distal extremity of a hollow outgrowth from the parent and then separated by constriction of its base. When it is cool and little food is present, there is a multiplication of the interstitial cells of the ectoderm causing conical swellings or testes. The cells, when mature, are spermatozoa and shed into the water. At the same time, one out of a mass of interstitial cells swells and becomes an 'ovum,' which is, in the usual way, fertilised by a spermatozoon.

In hydrozoa, the hydroid polyp, after budding, and forming colonies, gets other buds—'sporosacs,'—which contain the sexual products. Sometimes a separate body of a gelatinous nature, but without mouth, forms, and remains attached. This is otherwise a separate individual and forms the reproductive organs. In yet

further advanced stages, this body, jelly-fish or Medusa (*Sarsia*) breaks entirely loose from the polyp (*Syncoryne frutescens*) after having developed a mouth, stomach, nervous system, eyes, etc. The polyp which gives rise to the medusa *Aurelia aurita* undergoes a series of transverse constrictions which produce a series of the jelly-fish. The thus liberated medusæ develop arms, tentacles, radial canals and reproductive organs. But in this, as in the former example, the conditions are not such as to perpetuate a division 'medusæ'; and the reproduction after fertilisation, reverts once more to the zooid type, hydroid or polyp.

Similar reversions to the original type, after having for a longer or a shorter period deviated from the fundamental stock, can be found in plenty in the well-known cases of 'alternation of generations.' Ferns and mosses are alternately assexual and sexual, and the fertilised ova of the latter return to the former. The fluke produces several assexual generations as 'rediæ' after quitting the sporocyst. Some, but not all rediæ become tailed 'cercariæ,' which swim on to grass or reeds, and swinging off their tails, encyst. These encysted cercariæ, when eaten by an animal, become again flukes.

These instances have been mentioned merely to show there is not always a tendency to reproduce a like or similar organism. There is a reproduction of the conditions of life, but not necessarily a reproduction of kind.

When we advance, we find that budding and fission, as factors of reproduction, are entirely wanting, and special cells become set apart for reproduction, the ovary with its ova and the testis with its containing spermatozoa. Reproductive organs are not glands, and *liberate* reproductive cells, differentiated elements, not products of secretion; although the anal glands, which have a fatty or oily secretion, and have a strong smell, are "doubtless auxiliary to sexual attraction." The ovum, although living, cannot, in the usual run of things, itself reproduce itself or anything else (*vide* p. 229), although, with outer aid, it may do so. All living things therefore do not reproduce, although, given certain conditions, which are of a purely physico-chemical nature, they can do so: they have the power to do so.

The organism which gave existence to an ovum or ovæ or spermatozoa has less power to reproduce than that which multiplies by budding and fission. An ovum just waits for a spermatozoon or a chemical substitute (*vide* pp. 229, 230), failing which, it dies, and no

new life is forthcoming. In like wise, the spermatozoon, which does not live like an animal (*vide* p. 156), decomposes if within eight days it does obtain conditions such as would result from its meeting with, being sucked in by and being reacted on by an ovum.

In the relatively primitive state of hermaphroditism—as instanced in the ascidian or the fluke (*Fasciola hepatica*), the ova of which are fertilised by male elements of the same animal—we find the closest connection of differentiated sex-cells after the state of uni-sexuality has been left. Budding and fission are only possible when the organism has many different units, just as where one organ takes upon itself several functions.

From the point whence duality of sex sets in, the chances of reproduction become ever smaller, and the fact that the number of different organisms which are uni-sexual is on the wane, whilst the class of dual-sexuality is on the increase, demonstrates that food supply must be on the decrease. This may ultimately tend to a final extinction of life.

Most fishes, reptiles, and birds, as also insects, come to maturity after having developed from spawn or eggs. There are of course exceptions. Thus, the fish *comephorus*, which inhabits Lake Baikal in Siberia, and is to be met with at a depth of 12,000 feet, brings forth living young ones into the world. Viviparous reproduction is also to be found in the sheep-louse (*Melothagus ovinus*), in some species of blow-fly and so on. It is just such exceptions as these which go far to discredit the theory of evolution. As I have already hinted in this section, there is little doubt that species do exist as a result of evolution, but it seems just as evident that other species come into existence by methods not yet perfectly understood. On the other hand, excepting the ecidna and duckbill, most higher organisms, including man, hatch the eggs or egg within the body.

In most cases of budding and fission, multiplication is very rapid. When sexual multiplication sets in, this tendency to rapidity is kept up by the great number of sexual organs, either ova or spermatozoa. This means, either that subsistence is failing, or that the conditions or/and food are changing. This failing or/and this changing goes on to such an extent, that soon there is even not enough matter of its kind thus to break up. The result, as we see it, is a gradual decrease either in the number of simultaneously ripe ova or/and spermatozoa or in the opportunities of these to conjugate. Many of the lowest grades, even if reproduced, barely maintain life, or find it difficult to discover the environment adaptable to their further existence. So

deteriorated have the conditions which are favourable to the vitality of the fluke, that it is by the merest 'fluke' that it remains living, and this sole chance of the embryo, after leaving the egg and swimming with the aid of cilia, is to come across and be able to affix itself to the aquatic snail *Limnæus truncatulus.* Once this latter has been met, the former immediately bores a hole into the interior, and after losing its cilia, enters a new stage as sporocyst.

See what difficulties there are in the way of bringing forth a human being. The human egg, only partly formed, is not at first contained in a Graafian follicle, but gets there by means of being tilted into certain canal formations which extend to the interior of the ovary. If the tilting process fails, or should the ovum meet with misfortune in these tubular recesses, it never reaches maturity, and the process either entirely ceases (there is disease) or it starts afresh later on. Even when it has reached the ovary, it is not certain that the ovum will be perfectly formed with a yolk and skin by being surrounded with cells. Much depends on the condition or health of the ovary. The finished egg or ovum, when nearly ripe, may, by impregnation, be torn suddenly from the ovary; but this is rare, and in the usual course of things, an ovum leaves the ovary at each menstruation, of which act this matter is the symbol or herald. The egg is next ejected into the oviduct,

> "the ovum with its *discus proligerus* is ejected, and brought into the abdominal ostium of the oviduct,"[1]

the mouth of which is in no anatomical connection with the ovary, but only with the womb. Should the follicle not burst sufficiently violently, or should the fringes which line the mouth of the oviduct or mother-trumpet (so-called from its shape) not become erected and catch on to the ovary, through want of sufficient nerve excitation or collection of blood, the egg falls into the hollow formed by the belly. If the egg was at this time fertilised, this mishap is very serious, as it is the source of *Graviditas extrauterina* or pregnancy outside the matrix, which as a rule leads to a most wretched death of the mother.[2]

The tiny spermatozoon, at the rate of an inch in ten minutes, by osmotic action in the fluid of its environment, and by the peristaltic motion of the narrow canals through which it wends, makes its way through vagina, and *viâ* womb or matrix along the oviduct to the

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[1] "Elements of Histology," p. 276, by E. Klein, M.D., F.R.S.; pub. Cassell & Co., London, 1895.

[2] *Vide* Prof. Büchner's "Licht und Leben," p. 252.

ovary, which may take it any time up to eight days. Meeting with no egg, it breaks up—dies. The secretions in the female sustain the life of the male seed. Without, death is more rapid. The life of a spermatozoon can be artificially prolonged outside the body.

A woman is perfectly free from conception for the eight or twelve days which lie in the middle of any two consecutive menstruations. Moreover only the very smallest number of spermatozoa ever reach an egg. Only one can enter and be harboured permanently. The majority die without or more seldom within it in thousands. There are even spermatozoa with non-motile cilia, *i.e.* the entrance of which into the translucent skin or *Zona pellucida* of the ovum can only be brought about by external influence, attraction and the like.

Very seldom are twins born, and scarcer still are triplets, fours or fives. Moreover, whilst primitive woman easily gave birth to offspring, it is rare in our days that a woman can be delivered of her progeny without the assistance of another person, her life being else at stake. Women are more sensitive to pain than they were. All this is brought about by the natural conditions of civilisation.

Again, our dear maternal ancestors, sweet souls, were satisfied to cook, to give birth, to take care of their children. Our modern woman must needs play tennis, golf, cricket, go to amusements galore, and be on the search for finery, or she must run to the other extreme and preach on some out of the way platform that which she does not herself exercise, and spinsters wax eloquent on infant rearing and child education. They enter the arts, in which they seldom or ever excel. Women are teaching in schools, are on the stage or otherwise independently earning a living in competition with men, who thus often find themselves too poor to marry. All these traits in the modern woman distract her from ideas of fulfilling the functions of maternity.

And the final result? Women find that the less children they have, the more comforts they can procure themselves. French women have long since acknowledged this.

In the "Daily Mail" for December 20th, 1905, there is an account of the proceedings of the English Royal Statistical Society. At a meeting held on the 19th, a joint paper, prepared by Drs. Arthur Newsholm and T. H. C. Stevenson, discussed the fact that

> "the inhabitants of the United Kingdom and other civilised countries are markedly less fertile than was the case but a few years ago. . . . . For the purposes of comparison the birth rate of Sweden in 1891 was taken as the standard, which is represented by 100. Taking the

period from 1881 to 1903, the following countries show a decline in birth rate :—

	Per cent.		Per cent.
Sweden	7	Denmark	15
Italy	7	France	15
Bavaria	10	England and Wales ...	17
Russia	11	New Zealand	18
German Empire	12	Saxony	24
South Wales	12	Belgium	24
North Wales	13	Victoria	25
Scotland	13	New South Wales ...	33"

Where the birth rate has remained comparatively high—Norway and Ireland—the countries have remained poor.

The more wealth in an individual family, the less, as a rule, the maternal care for children. In wealthy families the maternal stilling of an infant is getting day by day a more seldom occurrence. The rearing of offspring is left to third persons, and hence, even in the houses of the opulent, one finds a want of sufficient nourishment in the younger years, a want which the good feeding of later years can never balance or make good. This too, forms a factor in the reduction of progeny on account of premature death.

Quantity of food influences sex[1] in all animals, human beings included. Want of nourishment increases the number of males. In our times there is not sufficient food fuel to maintain the excessive output of energy demanded by the present exigencies of life: result —a too high percentage of males.

In bees,

> "Royal diet, and plenty of it, develops the reproductive organs of the future queens ; sparser and plainer food retards the sexuality of the future worker."[2]

Too much food has the same effect as too little.

Miescher found that the Rhine salmon fasts during its formation of sperm: that therefore little assimilation produces katabolic conditions.

Fast or over-living causes premature old age.

The sterility of women is on the incline and the fertility of men on the decline.

I believe I see another source for a decreasing population. In the "Daily Mail" for January 16th, 1906, is the following table, as estimated by the medical officer of health to the London County

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[1] *Vide* "The Evolution of Sex," chap. iv., by Geddes:

[2] Geddes' "The Evolution of Sex," p. 42.

Council, which gives the birth rate *per mille* for London for the last fifty-three years:

1851-1860 ...	... 33·6	1901	... ... 29·0
1861-1870 ...	... 35·4	1902	... ... 28·5
1871-1880 ...	... 35·4	1903	... ... 28·5
1881-1890 ...	... 33·2	1904	... ... 27·9[1]
1891-1900 ...	... 30·3		

which stands in immediate ratio to and varies directly as the temperance movement in England.

I have, alas, at the time when this work goes to press, not very many data to hand; but what there is, seems to demonstrate that a decrease in the birth rate is concomitant with the increase of ~~temperance~~. teetotalism

There were in London in the

Ten years to 1873.....6·48 drunk per 1,000 of the population
" " " 1883.....5·44 " " " " "
" " " 1893.....4·81 " " " " "

The value of these figures is ever so much enhanced when one comes to consider that to become intoxicated is much easier, owing to the inferior, quickly intoxicating quality of the liquor now being sold.

Rowntree and Sherwell[2] give us an annual *per capita* table from 1851-1898 of the cost of consumption, from which the following has been calculated, and which for the sake of comparison I have placed in juxtaposition with the above birth rate and drunken results.

	Cost per head.	Birth rate.	Drunkenness.
1851-1860	£3 2 5	33·6	
1861-1870	£3 10 3	35·4 ...	6·48 (1863-73)
1871-1880	£4 2 9	35·4 ...	5·44 (1873-83)
1881-1890	£3 9 10½	33·2 ...	4·81 (1883-93)
1891-1898	£3 14 3¼	30·3	

These *per capita* cost statistics are very misleading, as they are wrongly based on the false hypothesis that the increased consumption was brought about by the same percentage of drinkers. That this however does not represent facts is shown in the proportion of drunkenness. There was, during the years of greatest industrial and financial prosperity, more drink consumed; but this increase is to be accounted for in the wise that hitherto total abstainers drank, and very small drinkers indeed drank more. It will, however, be at

[1] Since writing the above, I read in the "Daily Mail" that the official birth rate return for 1905 is 27·2, whilst the death rate is 1·0 lower than in the preceding year.

[2] "The Temperance Problem and Social Reform," by Joseph Rowntree and Arthur Sherwell, p. 437; pub. Hodder & Stoughton, London, 1899.

a glance seen that in the periods of greatest general alcoholic consumption there was a great rise in the birth rate, and the birth rate falls with a fall of general alcoholic consumption. There was, as a matter of fact, the highest birth rate in 1876,—the year of greatest affluence and general alcoholic consumption.

As soon as moderation in drink is over-stepped a fall in the birth rate takes place. It is a fact that side by side with the advance of the temperance movement, there has arisen also greater intemperance of a few drinkers. There are fewer drunken per 1,000; but the drinkers drink more, especially the women.

In our conditions of temperature and pressure, a certain quantity of alcohol is requisite to energy. Teetotallers produce the least number of children, drunken people the next lowest, and temperate people give us the most offspring. It is the same with crime. Teetotallers provide us, says Rowntree (and he shows it statistically)[1] with the least number of criminals, those prone to inebriation come next, whilst criminality generally is recruited mostly from the great army of the moderates. It must, however, be noted that total abstinence is in itself not the only cause of least wrong-doing, of least child-bearing; but the character that has a tendency to teetotalism is a character usually wanting in intellectual and in animal energy, although he may and probably has will-power enough to be a total abstainer. It may however on the whole be assumed that total abstention from drink is natural to him or her. Rowntree's work[2] contains the following table, which vividly depicts the result of experiments which have been carried out in various counties of the United States.

	No. of Persons per Square Mile.	
	When Prohibition was adopted.	In 1890.
Prohibition States	16	25
Ex-Prohibition States	48	105

From the above table, it can at once be deduced that whereas the increase in the first case is from 16 to 25, or 1·5625 : 1, in the second it is 48 to 105, or 2·1875 : 1.

The lesson to be learnt is that alcohol in moderation increases the birth rate, whereas total abstinence and intoxication both decrease

[1] "The Temperance Problem," p. 481.

[2] *Ibid.*, p. 124.

it. We are living in a clime in which a certain modicum of alcohol is absolutely necessary to a bright intelligence and to reproduction. There is a tendency to drink more proof spirit.

But not only this tendency, but the unrest, the artificial life of society, the greater speed of locomotion, the telephone, and inventions generally, themselves the results of moderation, are the causes for intemperance and insanity.

Another production of moderation—religion—produces narrow-mindedness, *i.e.* a want of intelligence in other respects, leading also in the long run to religious mania.

I only mention these things that it may be made clear that moderation itself is no immediate cause for insanity, although it is the indirect instrument.

The increasing tendency to assimilate alcohol would appear to be commensurable with changes in terrestrial and climatic conditions. Thus, for the years 1891-1896 the *pro capita* cost of spirit was :—[1]

1891	£3	15	0	1894	£3	11	6½
1892	£3	13	11	1895	£3	12	9¼
1893	£3	12	3	1896	£3	15	6

Thanks to the kindness and politeness of Mr. W. Marriott, Secretary and F.R. Met. Soc., I have been able to obtain the following statistics from the Royal Meteorological Society's library :—

Year.	Average height of Barometer in London, reduced to sea level.[2]	Mean Degree of Humidity. Saturation = 100.[3]
1891	29·969	83
1892	29·954	81
1893	29·995	78
1894	29·969	82
1895	29·924	79
1896	30·022	80

If now, I re-order these results according to alcoholic consumption and multiply the barometric height by the degree of humidity, I get,—

[1] Rowntree's "The Temperance Problem," p. 437.

[2] "Quarterly Journal Royal Met. Soc.," art. by R. C. Mossman, F.R.S.E., F.R. Met. Soc., vol. xxv., 1899.

[3] "Results of the Magnetic and Meteorological Observations made at Greenwich for each Year," Ed. by W. H. M. Christie, C.B., M.A., D.Sc., F.R.S., Astronomer Royal; pub. Neill & Co. Edinburgh.

Cost.	Pressure × humidity.	Av. annual temp.[1]
£3 11 6½	2457·458	
£3 12 3	2339·610	
£3 12 9¼	2362·996	
£3 13 11	2426·274	
£3 15 0	2487·427	mult. by 43·9 = 109198·045
£3 15 6	2401·760	„ „ 48·1 = 119524·656

which, with the exception of the first, shows a simultaneous increase in both columns. Where a decrease is shown, it is amply compensated for by a rise in temperature.

Reproduction is therefore interchangeably dependent on temperance, climate, and industry. But as the results of moderation are themselves the sources of excess, it stands to reason that the birth rate will gradually sink despite a temperate use of alcohol and a fairly constant climate.

It may not be out of place here to remind the reader that that which is obnoxious to the corpuscles or cells of the blood—rain or spring water—is also deleterious to the movements of the reproducing spermatozoon, which is thereby drawn up or contracted into a loop.[2] This action or reaction of water to retard spermatozoic movement can be annulled and motion again quickly resuscitated by a slight addition either of salt (NaCl), sodic or potassic phosphate, or albumen; whence it may be seen that not only albumen, but also other substances are available to maintain the condition we call life, —a subject about which there will be more said anon. I have simply tersely referred to the matter now, to show that reproduction is actually inhibited by teetotalism in so far as one is forced to consume, in much greater quantity, to spermatozoa injurious water. In this connection, it may also be of interest to call attention to the most beautiful and interesting experiments with bees carried out by A. von Planta,[3] which shows that to develop queen bees from the larval condition, there is only 69·38 per cent. of water in the nourishment provided, whereas for workers there is 71·63 per cent., whilst drones come forth where nutriment containing 72·75 per cent. of water has been deposited within the cells. The more water, the less sexuality.

On all sides there is apparently a tendency to depopulation. Terrestrial conditions are changing, there is less fertility in soil, there is a diminution in the temperature of our globe, so also is

[1] *Vide* note [3], p. 239. [2] *Vide* "Licht und Leben," by Büchner, p. 258.
[3] *Vide* "The Evolution of Sex," by Geddes, p. 43.

pressure altering, as are many other physical and chemical conditions, all of which variations have a katabolic tendency and

"Katabolic conditions tend to produce males,"

whilst not males but

"females have been already seen to be more anabolic."

As too, aboriginal races are numerically decreasing, it seems to stand out clearly that there is a general tendency for the entire human race to die out, to become as extinct as the dodo. The conditions favourable to the state of life are on the wane. Reproduction is failing.

Will it entirely fail as a characteristic of living matter, and will in the end such living matter be perpetuated as Loeb did that of the sea-urchin—inorganically? Will man evolve and become something else, or will life cease with the absolute dispeopling of our globe?

I feel I ought not to leave this item of depopulation without a reference to a not by any means unimportant physiological phenomenon. Warmth is unconducive to the production of nucleïn and nucleïn is unfavourable to a production of females and propitious to that of males which are not so reproductive. The cooling down of the world is momentarily abetting the birth of males, speeding depopulation.

We now leave the physiological, sociological, and chemical sides of the question and turn to the physical aspects of reproduction.

It has, in an earlier part of this work, been shown that when a mother-cell divides into two daughter-cells, that these latter were at the outset, not so saturated as the mother-cell. Both Spencer and Geddes explain this by demonstrating that whereas the surface increases as the square of the diameter, the mass of a sphere increases as the cube, and the increase of surface being disproportionate to that of the contents, a stage is arrived at in which there is less opportunity for nutrition and excretion of waste. Thus, the collecting waste tends to rend asunder, and that rent asunder is unsaturated (unnourished). The two parts gain new surface and thus assimilation can set in anew. This, in brief, is cellular reproduction.

It must be borne in mind that in discussing the question of reproduction, we are not touching abiogenesis; but only seeking for the origin of life from life and dead from dead. Life from life is conclusively shown to be a process of a nature purely mechanical and controlled by physical conditions. Moreover, attention has

been called to the fact that all living things do not of necessity reproduce their like, but that external inorganic environment and physical conditions can amend the entire constitution and construction of the new individual. The only thing that continues is the condition of life itself, even which latter was threatened by the very act of reproduction. If, for instance, respiration is prevented during growth, death occurs. This can be experimentally shown, for it, like perspiration, can be prevented by smearing a plant with oil. In both cases the cells burst before they are ripe (fully grown).

This phase can be repeated in inorganic mass, for if I put a quickly decomposing compound—the decomposition products of which possess great expanding energy—into a very thin bladder, the bladder will burst and the explosion will destroy the original mass quicker than had the substance never been placed in a bladder at all.

In all-too-rapid growth of the interior, waste too, is continually on the increase, and want of excretion brings about dissolution or death.

Reproduction can be hemmed or restrained by changing the environment. Thus, when American fruits are now sent to London, they are placed in boxes from which all air has been exhausted and in which the vacuum has been replaced by gases which possess the attribute of retarding the ripening. The tendency to live and to reproduce life's conditions is often very weak indeed, and one might almost be led in some instances to call reproduction the merest chance work. The conditions are in general such that they are in our days easier overthrown than maintained.

Is there any reproduction in inorganic mass? This question might be put in another way:—"Are there any inorganic systems under conditions of combination and interaction of given physical forces, which, due to a state obtaining in the environment, can reproduce a similar system under similar conditions of force combination and interaction?"

In living matter, rapid growth and therefore rapid dissolution or rapid reproduction may be brought about by a large supply of nourishment.

In December, 1904, Mon. Albert Robin made a communication to the Paris Academy of Medicine regarding the therapeutic action on the human system of very finely divided mineral matter (the highest homœopathic dilutions) which show that electrons exert influences analogous to those of encymes, functions productive of results which

are apparently irrespective of the quantity of the ferments. The very presence of these, seems to throw the *status quo* of that attacked out of equilibrium; it breaks up and sometimes, if conditions be propitious, the products of decomposition re-form to build up another body, not quite, however, of the nature of the first.

When liquids crystallise, they can only do so after sacrificing their nature as liquids: the liquid construction must break up before the crystal can form. Moreover, in any case, there is the absorption or addition of so-called 'water of crystallisation' from the environment.

When the spermatozoon breaks up and loses its identity in the ovum, other spermatozoons can, from such a union, be reproduced if the conditions be favourable; but the reproduced spermatozoa are first found at the very end of a long series of alternations of generations of cells after the body has been constructed. In inorganic mass the action of reproduction is more direct.

If, in a nearly crystallising solution of sulphate of soda, a single already formed crystal of the same compound be thrown, the entire liquid will at once crystallise out. The one crystal has helped to bring about conditions favourable to the production of very many crystals. This kind of multiplication is also to be found in many other chemical compounds. Fertilisation of crystals has taken place. The liquid breaks up on receiving the crystal nourishment, and the reproduction of more crystals has been brought about by the activity of one in a medium (the fluid) favourable to reproduction.

I do not suppose that Dr. Higgins quite intended to put the construction on his words that I do, when he wrote[1] of

> "the fact that structure is crystallised function,"

but it does indeed seem a fact that the more one dives into the depths of mystery surrounding living protoplasm, the more the conditions of life appear to be those pertaining to a body about to crystallise,—a fact at which, in the course of this work, I have more than once hinted.

The only difference, if difference there be, between living and dead reproduction, seems to be one of time or duration during which the phenomenon takes place and continues. Whereas the living reproduction takes place in many cases after months of development

[1] *Vide* art. 'Is Man poltophagic or psomophagic?' by Hubert Higgins, M.A. Cantab., M.R.C.S. Eng., L.R.C.P. Lond., in the "Lancet" for May 27th, 1905, p. 1417.

and may continue from generation to generation for years, reproduction in the dead world takes place in general only in minutes or seconds, and in this short space of time generation only up to the third degree can with any certainty be counted, except in one or two instances to be mentioned later. No hard and fast line of demarcation, however, exists between the duration of development required for the living and that for the dead system.

This reproduction in the dead world I have observed to the best advantage in snow-flakes, although it undoubtedly takes place elsewhere.

Thanks to the kindness and politeness of Mr. William Marriott,[1] I am permitted to reproduce some most beautiful illustrations of snow-crystals (Fig. 9*a*) as seen and noted by Mr. J. Glaisher, F.R.S., and which were found among his papers after his death.[2] If the reader will carefully study these flakes of snow as well as Mr. Glaisher's other figures, of which he found in all about two hundred, and also those which have fallen under the observation of others, he will without doubt come to the conclusion that here the phenomenon of inorganic reproduction has taken place.

An exact study of flakes of snow has convinced me that although most of the crystals are six-rayed stars, there are exceptions, and these exceptions go far to demonstrate that we have here to do with two distinct systems: either a hexagonal with a square, or more likely a system of two with a system of three, for the hexagonal really appears to have evolved of a triangular form. The first shape of the one system presented probably a plane triangular surface. In crystallising, it divided at the centre. This simplest form I have not been able to find, but shape 44 (Fig. 8) is actually existent, which is a triangle with its sharp angles cut off. This divides at its centre till we get 39 of Fig. 8, a form likewise to be seen in nature. By further development, the lines separate, and in separating, go ever nearer to shaping themselves to three straight lines which is attained naturally (33 of Fig. 8). This easily advances to a six-rayed star, and this again by a complexity of exterior conditions, accretions, and division (Fig. 10) becomes a hexagon (38 of Fig. 8). The hexagon in dividing, at length attains the beautiful forms which so delight our more artistically disposed scientists. But another system has been at work. Nutrition has been provided by

[1] Secretary and F.R. Met. Soc., London.

[2] These were first published by Mr. Marriott, on behalf of the Royal Met. Soc., and form plate 2 of the "Quarterly Journal of the Royal Meteorological Society," vol. xxx.

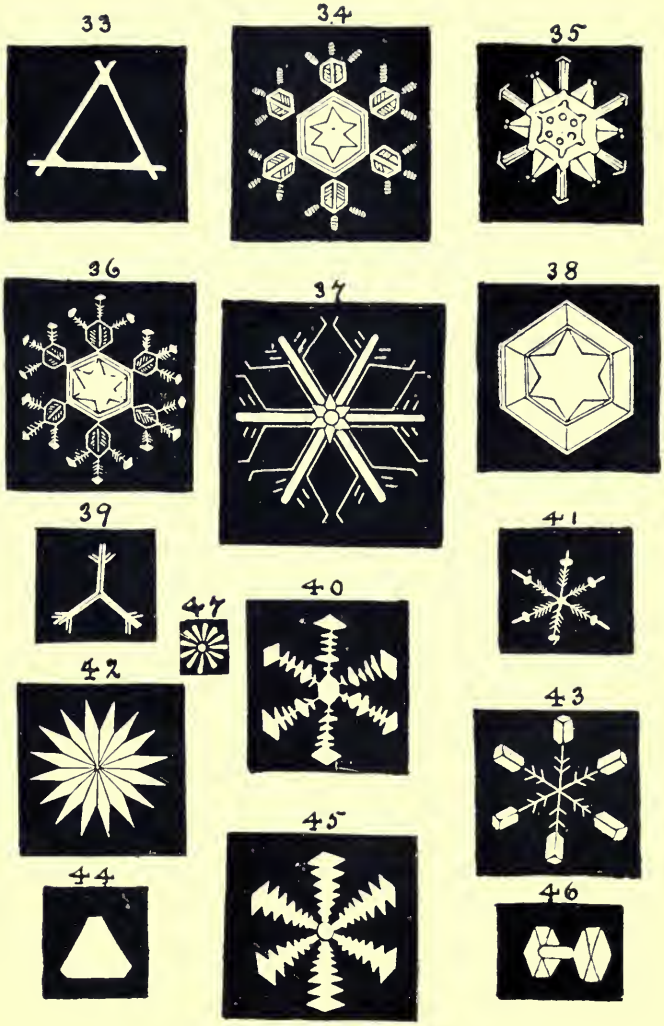

Fig. 8.

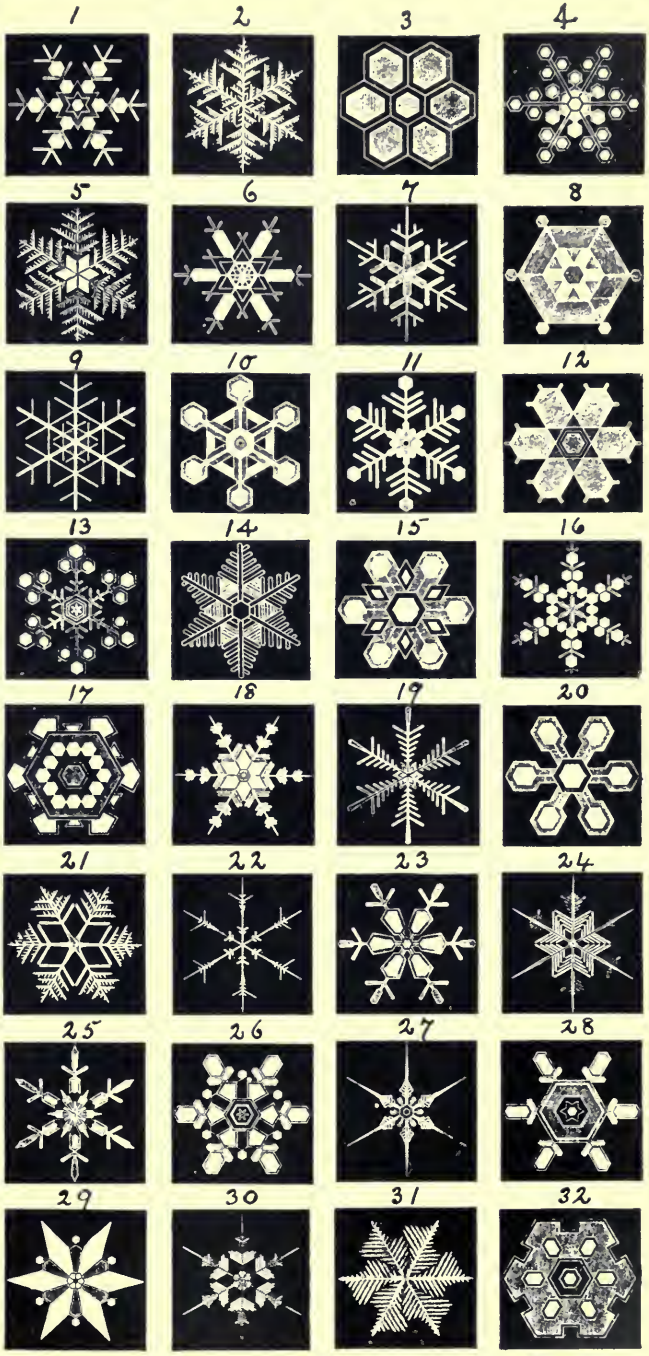
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Fig. 91.

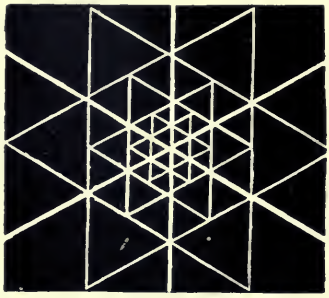

Fig. 9*b*.

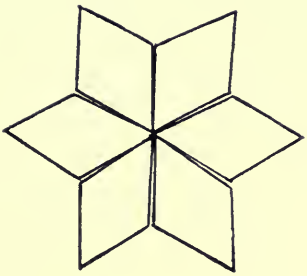

Fig. 10

a system, the fundamental unit of which is 2. This may be seen in a somewhat rarely met with dumb-bell shape (46 of Fig. 8) produced by the joining of two hexagons, each of which, be it noted, has but two diameters. In 43 of Fig. 8 there are actually rectangular developments, whilst in 40 and 45 the six rays are made up of four-sided plates (in the first case apparently rhomboidal, in the second rhombic), whilst 37 contains vestiges of four-sided development between the six radii, 47 is a twelve-rayed star which might be defined as a system of 2×6, and to dissipate all further doubt, 42 shows us a very seldom seen sixteen-rayed star formed of long-shaped diamonds, in which therefore no vestige either of 3 or 6 or a multiple of these can be recognised. 35 is, to all appearances, a combination of the 2- and 3- system, and the 2- system may be identified in the rectangular formations of 29, 87, 26, and 28 of Fig. 9*a*.

Quite superficial scrutiny of 40 and 45 of Fig. 8 might lead one to a conclusion that each lozenge in the line of a ray was the reproduction of its predecessor nearer the centre. Only the centre here is hexagonal, and the conditions not being adequate to maintain the species—if I may be permitted to make use of biological terms—there has been a reversion to an earlier embryonic form,—or is it partly the hexagonal ovum and in part the diamond sperm?

But we have, in Mr. Glaisher's stars, much better proof, and we shall do wisely to examine these more closely. Turning to Fig 9*a*, star 24, we see that each rhombus of the star of Fig. 10 breaks into concentric rhombi and that these again divide longitudinally. In so doing, the three main diameters of the duodecagon become denser. At the same time, at the periphery of the star, certain parts are seen forming on the diameters at a given distance from the centre and in which periods of greater reproduction are well marked, as one may see by casting but a cursory glance at stars 22, 11, 30, etc.

Now one of three things may occur. Either the duodecagon may dwindle right away, leaving little but the bare ribs (22); or a centre may fall out (14); or there may be a combination of both these processes (7, 21, 30). Most probably the third is an intermediary process between the two former.

These dividing-up tendencies in snow crystals which gives them their charmingly airy appearance, I have tried to illustrate more lucidly by reconstructing the star 9 as shown in Fig. 9*b*.

Whilst dividing is going on in one direction, concentration and accretion is going on in another, and stars 9 and 8 show the development of a hexagonal from the star form.

And now, after this long introduction, let us turn to star 12. Here evidently, decomposition or dilution has been going on in the centre, and condensation on the circumference. Yet this condensation does not appear to be produced by external conditions only, for against this supposition are the three protuberances of each ray, which seem to speak of electric or similar conditions of energy being in function at the angles or points of discharge. As yet further evidence of the existence of external action, reference can be made to the form 31, where over-growth of the branches on alternate sides has prevented a similar growth on the sides of the radii nearest the superabundance. This stoppage of growth at one point on the radii has resulted in a redundance nearer their extremities. That there is here no melting away of parts is made amply clear by perfect regularity and the entire absence of any branches crossing from one radius to the other, as might have been, but is not, the explanation of form 9. The reason for the alternations in the length of form in 2 and 11, or for the internal spaces of 25 is not so clear, though evidently also internal.

In the main, the figure 12 has two parts: a dissipated inner star as centre and six somewhat more concentrated hexagons exteriorly. In star 3 there is a central condensation which has caused the outer hexagons to break loose and, while themselves increasing in intensity, to surround themselves with a less dense environment. In star 20, the inner hexagon has yet more condensed or become saturated, and the peripheral hexagons have done likewise, whilst their envelopes have lengthened and formed necks towards the centre. The life-history of this crystal cannot positively be followed, but it can be guessed at, by comparing it with 15, which is to all intents similar, but with the addition of rhombi which shows a part-reversion to a former embryological type which is yet more marked in star 29; and with star 10, the construction of which is more varied. In it, however, 20 is again produced, only with this difference, that the neck of the envelope has narrowed and lengthened, the contained hexagons are being more fed from the centre, whilst the end of the neck nearest the outer hexagons is the narrowest of all. By taking here rather a long jump, we land on star 16, which not only shows the newly produced hexagons, but hexagons between these again, and budding up to the third generation. The hexagon of the last generation is nearly free to break off and live on its own account and develop further stars.

Similar conditions obtain in 4 and 13. In star 1 the hexagons are

fairly independent. Star 17 seems to be an instance of internal budding or of a state prior to fission.

There are, as Plate 9*a* shows, many ways in which the hexagon snow crystal can be produced. I have not gone to the absurd extreme of trying to prove that star 10 is a later stage than star 20, but hope conclusively to have proven that after the growth of snow crystals, there is actual reproduction—sometimes of the original type, sometimes an alternation of generations (stars 1, 11, and 16, etc., are a combination of 4 and 9), and sometimes of a type different to any (26 and 28, or 23 and 27, etc.), but these last can yet be traced to some prototype. A system of radix 2 fertilized a system of radix 3 and production has been the result. This result is the more amazing, if one bear in mind that in these crystals, not only water but other foreign matter from the atmospheric element has been assimilated. All this has of course been done very rapidly; but the fact remains: *reproduction in dead mass does exist.* Reproduction in living matter is slower in its action, that is all.

The reversion to early embryonic types is beautifully shown in stars 34 and 36, which not only have both star and concentric hexagon; but the reproduced or new-born hexagons whilst bisected longitudinally and forming 2 cells, again reproduce a group of three rays each of which in its turn again, in star 36, develops a single rhombus or four-sided surface.

On page 243 was shown that under favourable conditions, a crystal of sodium sulphate can out of its environment reproduce other crystals of sodium sulphate. Crystals of sodium chloride (common table salt) seem to have, under other conditions not yet, alas, definitely fixed, a similar property. Has radio-activity anything to do with the phenomenon? So sensitive is salt to physical action that $\frac{1}{9,000,000,000}$ of a gramme of it can be detected by spectral analysis. Although salt will kill vegetable matter, as any gardener knows, for he kills the weeds on his paths with it, yet there appear to be states in which it not only enters into the life of the vegetable kingdom, but seems itself to live, to be able to impart all its characteristics hereditarily to its reproductions.

A fungus, *Aspergillus niger*—related to the common mould fungus—was cultivated on a liquid nutriment that was strongly impregnated with cooking salt. As was not otherwise to be expected, the resultant fungi contained a large quantity of salt. But the spawn of these were then reared in a fluid entirely free of salt, and strangely enough, these also contained a remarkably high

per centage of salt which was fairly maintained through several generations. Now it is quite out of the question that the tiny amount of salt containable in one wee spawn were sufficient to strongly infuse with salt even a single generation, much less several generations. The phenomenon is not sufficiently explainable on the hypothesis that the plants themselves had inherited a tendency to absorb salt and did so with avidity from the air, for these actions go on in an environment from which salt has been most carefully eliminated. The story has been told that a few loaves and fishes sufficed to appease the appetite of a hungry crowd of many thousand heads. There is the fable that Elijah caused the poor widow's cruse of oil which contained only enough oil to last for one day to maintain a supply for many days. The Jews tell the legend of the multiplication of the Maccabeus' candles. Are we to believe that the minute fraction of a gramme of salt in the spawn was thuswise miraculously multiplied? Oh no! for all the elements of the miraculous have been taken from our universe since we have begun to accognise that there is but one continuous force taking, as it acts, many forms; so that only this in infinite space infinitely pervading force does all things and does them according to its nature or character, in compatibility with its attributes. All these attributes we can never know. Then if not by a miracle, salt must, under these conditions, have reproduced itself naturally. It may even be that the elements sodium and chlorine of the compound sodium chloride (salt) are not so elemental as is supposed, and that their factors have been assimilated from out of the environment, just as it was earlier in this work hinted at that iron was no primordial mass.

It may probably be urged, that salt would never have been capable of reproducing itself, were it not that it had its seat in a living organism—the fungus—and that therefore the reproducing salt was living and part of a living organism. Luckily, there is an instance on record, in which salt reproduced itself independently of organic life. Thanks to the kind politeness of the editor of the "Strand Magazine," I am able to reproduce a letter of Mr. T. K. Evans of Oxford,[1] and which, in the magazine, is accompanied by an illustration taken from a photograph. The letter describes

> "a jar originally containing ointment from a chemist, which has taken to growing. *It commenced growing in* 1886, *and has continued*

[1] *Vide* the "Strand Magazine" for May, 1902; pub. by Newnes & Co., Strand, London.

ever since.[1] Its growth consists of pieces apparently cracked off, only instead of coming loose, they rise up on crystals which gradually grow longer and thinner until about ¼ in. long, when they get too weak and a piece drops off. The enclosed photo shows a piece rising off the side and off the top and bottom. The piece in front has grown and dropped off the lid. The following was written by my aunt in 1894, being all she then remembered about it: 'The gallipot was sent by a chemist in Aberystwyth, filled with ointment, to Mr. W. Williams in May, 1883. It was soon washed clean, and remained empty for a year or two, and there was nothing remarkable about it. Then it was used for a week or two to hold salt and water; then washed out and left empty on a shelf. A year or more afterwards, in the spring of 1886, it was first observed to stand crookedly and to have its lid on one side, and, in fact, to be "sprouting." That summer *Mr. Fisher, demonstrator of chemistry at Cambridge, tested the crystals* formed in "sprouting," *and pronounced them to be salt.*[1] It has steadily continued to grow since.' From this you will see that three years elapsed between its containing ointment and beginning to grow, so that it is not remarkable what the ointment was had been forgotten."

Signed: M. T. K. Evans.

7, Clarendon Villas, Oxford.

The facts in the foregoing letter are vouched for by the testimony of three perfectly unimpeachable witnesses. In the case cited, reproduction of salt crystals has been constantly taking place from 1886 to 1902—a very long period of observation indeed. Moreover, the reproduction was carried out in part by fission, in part by budding, and all this after the wise and manner adumbrated by me on pp. 148, 149. Lastly, a glance at the illustrations accompanying the original communication will suffice to convince one that the reproduction was carried on with certain hereditary characteristics of construction, the conglomeration of salt crystals, which here take the place of cells, taking up approximately the shape of parts of the gallipot itself.

I have myself seen similar excrescences on old English brown earthenware which most likely were due to some allied causes, but have, alas, kept hereof no trustworthy record.

It may here be added, that salt most probably, under certain conditions, not only reproduces but maintains the state or condition which we call 'life' and may even generate it.

I made a mixture of a very complex and uncouth nature, yet were the ingredients of the compound or the mixture not chosen at random, but after earnest thought. They were: para cyanogen and

[1] The italics are mine.

mercuric cyanide (both obtained by burning Pharaoh's serpents), sterilised urine (which formed the staple of the mixture), glycerine, *salt*, alcohol, ether, carbon di-sulphide, a modicum of sugar, free mercury, and animal sperm. This animal sperm dies within eight days. My mixture lay in an open saucer for more than nine weeks. Any spermatozoa that were originally in it, were dead. I had before me a dirty, slimy, muddy mass, under which the free quicksilver had collected, and above which green vegetable matter was growing in small patches made up of numerous scales or round discs. These were continually growing and increasing in number. As most of the moisture had evaporated, these discs seemingly absorbed some other ingredient, salt, mercury, and so on, and received no doubt much moisture from the surrounding atmosphere, the mean humidity of which for the period of observation being 80·7 (saturation = 100). The salient point of the experiment however is that although there had been degeneration from animal to vegetable life, there had been reproduction and maintenance of the conditions of life. Whether or no the maintenance was due to the presence of the salt or the compounds of cyanogen, or perhaps in this case both, it is of course difficult to say, although, according to the "Herald,"[1] Dr. Charles Littlefield, an Indiana physician, is said to have succeeded in generating animal life simply from a substance much of the nature of albumen, together with *salt crystals*, liquid ammonia, and alcohol. To be just, I have however heard no more of this, nor have I in any way been able to repeat these results.

Reference must here be made to the recent work of Mr. Burke.[2] He has taken a carefully sterilised bouillon or beef-tea extract, and after having added the usual gelatine for stiffening purposes, put in a minimum of radium bromide or radium chloride. It was not long before a remarkable growth appeared on the top of the gelatine, and, in spreading out in all directions, it had apparently all the attributes of a bacterial zoogloea. It is by no means unimportant to note that, like $MnCl_2$ and NaCl, Burke also uses a chloride. The creatures which Burke has brought into being have been given the name of radiobes. He calls them living beings —so do I. Lord Ramsay calls them bubbles containing a modicum of radium emanation (helium). Although I by no means share Lord Ramsay's opinion, he may be right; but this would in no wise

[1] A number in 1905.

[2] *Vide* "Nature" for May 25th, 1905, and "The Origin of Life," by John Butler Burke; pub. Chapman & Hall, London, 1906.

disqualify these animated little bits of matter, bubbles if you like, from ranking among other lowly forms of life, even though they be of the most primitive order. Let them be organic matter or let them be bubbles, then, as organic matter, or even as bubbles, they live; for they have one and all the attributes which we have learnt to conceive of as appertaining to living mass. They have a constitution, a shape, and a consistency peculiarly their own; like a prime organism they are provided with a nucleus and possessed of a boundary or cell wall; they gradually grow; last and not least, on the cessation of growth, they segregate and reproduce—increase in numbers. The reproduction is carried out by subdivision exactly on the lines laid down in this chapter—multiplication being the result of overgrowth.

It is only meet to conclude this section with an allusion to contemporaneous experiments carried out in the physical department of the Karlsruhe Technical High-School (Polytechnic). The German account[1] which opens with a witty and appropriate allusion to Goethe's "Faust," Part II., wherein Faust's Famulus essays from the crystallisation of a solution to produce a living being, an homunculus, goes on to say that already at a later date it had been noted at the Institute that there are substances (solutions tending to form emulsions), such as soft soap, which under suitable conditions take the outline of exceedingly soft nigh liquid crystals, shaped as are solid cubes, prisms and the like; which on an increase in the surface tension and raised degree of cohesion (the results of continued cooling), fell to spherical drops as in the usual liquids.

More recently, new drops of the consistency of olive oil have been observed, which act to all intents as living infusoria. In growing, substance accretes (or is assimilated) at all points of the surface, till at last, a sine-shaped depression with a straight line reaching to its centre, resembling as much as anything a mouth-opening prolonged into an intestinal canal, begins to act not as an assimilating but as a reproductive organ. Suddenly one sees a second drop breaking forth in such wise, that the intestine of the parent-drop is prolonged into the middle of the new-comer, which soon assumes the size of the parent and then falls off—a sort of cell division exactly that of infusoria. (Compare with p. 196.) The entire process, which takes

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[1] "Frankfurter Zeitung" for December 12th, 1905, containing an abstract from the "Karslruhe Zeitung," the official organ of the Baden Government. The phenomena are to be studied in greater detail in the "Annalen der Physik." *Vide* also short accounts in the "Times" for January 3rd, 1906, and "Knowledge" for May, 1906.

place with a lightning-like velocity, gives one the impression of looking at a drop of water through a microscope.

As to the shape of the drops, it is much what one might theoretically expect and is but an amendment of Fig. 15 (*vide* p. 357). The probable formation of living matter as a mode of crystallisation was foreshadowed by me before I heard of these experiments[1] (*vide* pp. 145, 148, 150 and 199 ¶ 3. Compare also p. 243), and is now tantamount to a certainty.[2]

In the solutions above described, there are many variations of the forms assumed, which do not here call for especial mention; but we must note shapes like a stroke or thin bar, moving exactly like a bacterium, and above all such as appear in every way similar to spermatozoa or seed-threads with a gradually thinning tail which is the means of its slow tortuous propulsion. Although the Karlsruhe authorities seem to have propounded for all these phenomena alike, a cause based on very slight variations of temperature, yet I still maintain that the origin of cilia is, if not entirely, yet partially electrical (sudden rises of potential), although temperature and no doubt even pressure[3] are factors (*vide* pp. 129, 150, 157 ¶ 1).

Other forms which were observed to have been taken up are drops which drew themselves out into thin bars after the manner of Cladothrix (*vide* pp. 156 and 151), and sets of three little bars, joining themselves together to a single symmetrical three-rayed star,—which latter goes far to corroborate my hypothesis as to the growth of snow crystals (*vide* pp. 244-246 and especially star 39 of Fig. 8 and p. 244).

But the important item to be borne in mind is that we have here in nearly all the forms reproduction in inorganic matter (or has it through living become organic?), which is absolutely analogous to the varied forms of reproduction of living protoplasm.

Summing up the results of this section, we have Burke and the physical laboratory at Karlsruhe reproducing living from non-living organic and inorganic matter. I call this reproduction, because by the transition from the inanimate to the animate condition, there is a multiplication of bodies at the expense of the environment, although that produced is absolutely unlike that whence it originated. Slightly in advance of this, we have the reproduction of salt from salt within a living organism, as illustrated

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[1] All pertaining to these experiments in Karlsruhe has been inserted at the last minute before this section went to press.

[2] Will not the crystal 'Spermine' (*vide* p. 160), in the light of the above research work, now be able to give us a definite clue to the artificial production of spermatozoa?

[3] Compare also with the close to the last ¶ of p. 192.

in the experiments with fungi, and capping this, the reproduction of like from like, from dead inorganic mass to dead inorganic mass both in the case of the snow crystals and the salt crystals of the gallipot. Not the slightest boundary line can be drawn between the reproduction that goes on in dead inorganic mass and live organic matter.

The Life Problem.

Step by step, point for point, science has shown that all which has been hitherto deemed supernal, could be brought about by the force or force-forms of the universe. Whether or no this infinite force be itself supernatural [1] remains to be seen. One thing only had hitherto eluded us: The Condition of Life. Could that be brought about by this force ? If not, then did life originate, either in something exterior to infinite force (which were impossible, by virtue of infinity), or were force not itself integral, but the resultant of at least two components, the one factor being physical, the other hyperphysical. But the thoroughly impartial manner in which, in this chapter, one by one, the six essentials to the conditions of life :[2] the powers of motion (by stimuli), assimilation, growth, secretion, excretion, and reproduction have been shown to exist also in the inorganic world, gives us absolutely no reason for having to assume that force is in itself divisible. On the contrary, we have seen that each factor of the ultimate condition was itself of a physical nature and could be influenced by physical agency. This fact must cause incalculable iconoclastic havoc on the altars of the church. The, through untold years, most jealously, carefully and rigorously guarded shrine has been ruthlessly invaded; the mysterious idol which the church made out of life, has been rudely torn from off its pedestal, hurled against the rocks of a premiseless science and prejudicially free research, and been broken to fragments. There is nothing in the live world, that is not to be found in the non-living.

And yet it would not be correct nor true to state that all mass lives. Evidently a difference does exist between the realms ruled o'er by Death and those over which Life holds mystic and mighty sway. And this difference ?

Careful consideration and examination of the details before us, seem to conclusively demonstrate that, whereas in some living masses all of Prof. Halliburton's six characteristics of life can one after the

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[1] This is the fundamental principle of pantheïsm, or the doctrine of God being all things or the universe itself.

[2] *Vide* p. 176.

other be found; there is, up to date, no inanimate mass, either natural or artificial[1] and aided by the employment of mechanical organisms, which is capable of assuming them all; although, as we have in the foregoing section seen, several of the attributes can be found together. True it is, that Burke's radiobes or bubbles have all six qualifications of the animated state, and that these selfsame radiobes or bubbles had their origin in dead mass, but then these are no longer dead but living,—their condition is physically other than that from whence they came. Verily albumen has not been yet synthetically set up; but then there is no ground for asserting that the formation of albumen is one of the adjuncts of the phase, although at the present state of our physical condition, incidental to it. Burke had his albumen provided for him in the sterilised bouillon, but the progeny which he brought forth have not demonstratively been proved to contain any of the albumen whence they sprang. Who says however that albumen is necessary to life? But I am anticipating.

There are living masses which do not exactly comply with all these six conditions. The embryo plant does not assimilate, all living protoplasmic cells are not capable of reproduction, and many die before having reproduced. Spencer's now celebrated apothegm that life is

> "the continuous adjustment of internal relations to external relations"[2]

does not hold good. Continuity is, as often as not, wanting.

The difference, then, between the two divisions, can therefore better be defined by saying, that in all living matter, there are potentialities which, under given conditions (temperature, pressure, environment, and so on), become active and can assume all the six states of reacting on stimuli, assimilating, growing, secreting, excreting, and reproducing, and only herein fail when the conditions fail; whereas dead matter has never simultaneously all these potentialities (though it may have several—and all six states are to be found in dead mass, but not in one and the same piece of dead mass) and can never, under any possible conditions whatsoever, assume all six states aforesaid.

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[1] As already explained, a machine is natural, having been made by man, himself a part of nature; but the word 'artificial' is here used in the old sense, to distinguish that part of nature including man, from the works of man, a distinction quite incorrect: for even animals such as the monkey and the elephant employ objects in self-defence instead of only their hands or/and feet.

[2] "Principles of Biology," vol. i., p. 80; pub. 1864.

Should therefore, by means of heat, pressure, environment, chemical affinity and mechanism, an organism be artificially constructed, capable of all six forms, or should all six forms be brought about by natural agency, then would that body no longer be dead but alive.

In Burke's experiment, the bouillon was dead, the radium chloride was dead. Neither the one nor the other had all six attributes of living matter, nor was it capable under any conditions whatsoever of assuming them. It is in vain that Burke still holds fast to the great illusion of biogenesis; it cannot support him, for bio-genesis is no more. Says Burke,

> "Radium, therefore, may be regarded as the seed, if we may put it so, which grows in the bouillon soil."[1]

Neither radium nor radium chloride has life in it and can therefore not be compared to a seed which has life in it. The radium chloride sets up in bouillon the live condition in the same way as we have seen sodium chloride or manganic chloride do, and as water in the soil does to the seed, not the seed to the soil. A desiccated seed might, a dead seed would never become alive by the action of water. Dead radium would not be animated by the bouillon. A "vital flux," as Burke would like to have it, does not exist; but a chloride may and certainly seems to possess the capability, under certain conditions of physical stress, of throwing a dead mass into the live state and sustains it in that state, as does water maintain the life of the seed. When, may be hundreds of thousands, if no millions of years ago, protoplasmic cells were first formed in the vast oceans that circled our globe, did not probably a chloride play the part of kissing the susceptible cell to life?

To repeat: we find that life is a state of matter by virtue of which, under certain combinations of physical conditions, it is capable of reacting on stimulation, assimilating, growing, secreting, excreting, and reproducing, and that this state of matter is brought about by certain combinations of physical forces, such forces including probably all those known to us and may be one or more at present outside our ken.

In dead matter such a complete and complex combination does not exist.

The sole difference therefore, between the two states of the living and the dead, is that the conditions for the maintenance of the

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[1] *Vide* J. B. Burke's "Origin of Life."

former include greater heterogeneity of force-forms assumed by the one universal force than do those for the maintenance of the latter: the live state is an advance over the dead one, an advance from a state of greater homogeneity to one of greater heterogeneity.

I say that life is an advanced state, simply because the dead state was, from our point of view, the first state of matter to come into existence, and not because of the greater differentiations of the former, as Spencer would have it. 'The advance' is that which comes in sequence and therefore maintains the force of the universe as an entire, whether it be more heterogeneous or more homogeneous, for if a return to a state of greater uniformity exists, it is necessary, and therefore is an advance. Spencer says:

> "Differentiation from homogeneity is progress."[1]

Absolute homogeneity can of course never exist; it is an illusion or else force were not, the universe were not. But in the life of an ascidian we do actually see a return to greater primitiveness (from our standpoint) known as devolution or retrogression, and yet it is necessary to a progress of the entire or else it were not there. (*Vide* pp. 60, 61, and p. 112.)

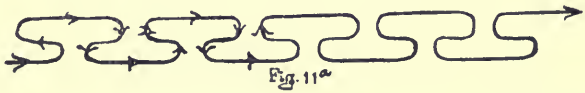

Fig. 11a

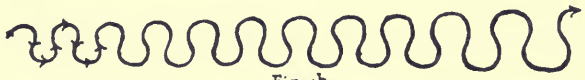

Fig. 11b

Fig. 11c

The path of progress may be a very peculiar one, made up of rises and falls in degrees of heterogeneity, probable forms of which are shown diagrammatically in Fig. 11.

It was shown that the tendency to reproduction is on the wane and may probably cease. This of course means that life may cease, yet the entire extinction of life from this world may mean an advancement as regards the maintenance of active force. There may be a temporary or even a continuous return to single physical force-forms, as we know them, and still in this return there lie the causes of future motion.

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[1] "Essays: Scientific, Political, and Speculative," vol. i., p. 9.

Life is not a force (there is no such thing as the vital force, principle or flux of mediæval physiologists), but a state or condition brought about by a combination of physical forces.

My dear and respected teacher of electricity, Mr. Hibbert, is quite right when he states that

> "Life is not energy nor a factor of it." [1]

But much as his former student-pupil still loves him, he is not able to agree with him in everything. Our views simply fail to coincide by reason of Mr. Hibbert's own phrases leading him astray. It is the ofttimes observed result that the most learned are often the most lax in expression. *E.g.*, he says,

> "Scientific knowledge is divisible into two parts dealing respectively with the inorganic and organic worlds. The organic (world) includes all living things: the inorganic all non-living things. For example, the inorganic (world) includes the phenomena of light, heat, sound, magnetism, electricity, hydrostatics, chemical action, etc. These are called the physical sciences." [2]

Our globe is dead and yet it is organised, and the ocean is, in this sense, one of its organs. The phenomena of light, heat, etc., are not things of the inorganic world, but the forces of light and heat or the forces which produce in us the sensation of light and heat are so. Neither the phenomena of light and heat, nor the forces of light and heat can be physical sciences, but their study is so termed. This laxity in the formulation of ideas, originally mentally correct, is that which strands Mr. Hibbert on barren ground. To this no doubt, he, like Haeckel, is helped by the assumption of the law? of the conservation of matter; [3] which hypothesis, as in this work is shown, stands on a very weak foundation. Most probably there is no conservation of matter, matter breaking up into non-material forces. In the argument (p. xiii.) stands:

> "Yet life has some relation to energy, and this is found to lie in its ability to direct energy into paths otherwise impossible."

Life being a state or condition,[4] it can never direct energy. The only relationship in which life stands to energy can only exist in the fact that the phenomenon of life is brought about by forces, the aggregate action of which represents so and so much energy. The

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[1] "Life and Energy," by Walter Hibbert, F.I.C., A.M.I.E.E.; chaps. i. and ii.; pub. by Longmans, Green & Co., London, 1904.

[2] *Ibid.*, p. 3.

[3] *Ibid.*, p. 4.

[4] Life is that condition of matter by virtue of which, under a limited degree or temperature and pressure (which appear to bear a given ratio to each other), it undergoes a succession or series of definite phases; life is no single resultant.

less there is of such forces—the ratio and condition of their combination being constant—the less vitality there is, the lower is the degree of the condition called 'Life.' He continues:

> "Life is not the only directive control of energy: force, temperature, etc., do the same."[1]

Not so; temperature does not control energy (for it is but a measure of heat); but heat, or the want of heat, does. Heat is a force giving us definite sensations; but it is not a form of energy although its quantity represents energy. A force is active, not so energy. Heat is active. (Compare footnote to p. 58.) Again,

> "These (force, temperature, etc.) are shown to be factors in determining a quantity of energy. Hence we have directive controls of energy which are factors of it; also a directive control (life) which is not a factor."[2]

Although, as I show (*vide* footnote[4], p. 257), life is no resultant, yet, for argument's sake, the aggregate of the force actions productive of the condition of life can be considered as such, but this resultant is not equal, could never be equal to the infinite force of the universe, and therefore this resultant would be a factor of universal energy and exert a directive control on the same. It is only however in this much directive, that it bears the same relation to the entire that any part of a thing does to the whole,—it influences but can never overcome the whole. Life, as a state or condition, can exert no control whatsoever.

The origin of living substance on this planet is no break in the continuity of development or evolution of matter, standing as it does in no conflict with our knowledge of natural laws—the already cited experiments of Charlton Bastian,[3] Beresford Ingram,[4] the work of Geoffrey Martin,[5] as well as my own remarks and observations go to prove this—nor is matter itself a break in the continuity of a growing combination of forces to form this matter; but there is in living matter no

> "enormous tendency of all forms of life to increase and multiply,"[6]

as Hibbert would have it. There was probably such a tendency, but now the tendency is, as I have shown (pp. 235-241) all the other way.

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[1] Hibbert's "Life and Energy," p. xiii. [2] *Ibid.*

[3] *Vide* 'The Simplest Kind of Protoplasm' in "Knowledge" for Aug., 1905.

[4] *Vide* 'Ad Infinitum' in "Knowledge" for April, 1905.

[5] 'The Nature of Life' in "Knowledge" for June, July, and August, 1905. *Vide* also this work p. 129 *et seq.*

[6] Hibbert's "Life and Energy," p. 68.

Malthus of course was right when, in his "Essay on Population," to which Hibbert refers us, he says that any form of life would soon fill the world *if* there were no checks. "Wenn das Wörtchen 'wenn' nicht wär', wär' mancher Bauer ein Edelmann!" Every force has its full effect, till acted on by some other force; and as there are infinite forces, or force-forms, every force or force-form must be acted on: even that complex body of forces which produce in matter the metabolic state of life.

Let us call this complex coalition of forces W. Life will ultimately cease, for W will be checked, and in the end be utterly broken up or metamorphosed. Katabolism is winning ascendency over anabolism. The forces W can never permanently control energy, for W is no permanent constituency. It, like matter itself, has come but to go.

Life can only exist as long as there is a non-living environment,—*all living matter was once dead inorganic mass till it became part of the living organism. The condition of life was not one without a beginning, but had its origin in non-living substance. Moreover it is not the living germ-cell that produces seed, but a body of cells constructed out of assimilated once dead inorganic material which joining with the matter of the germ-cell, enters the new state of life.* Were inorganic environment, through rapid assimilation and multiplication (the outward sign of reproduction) absorbed, life would be no more. But there is no chance of this conclusion. The finish is quite another, and I see no ground at all for Hibbert's gratuitous assumption of the existence of a

> "tendency to bring more and more of the energy of the physical world into the living domain."[1]

On the contrary, that estimable and astute thinker Martin draws an admirable picture of the causes which will lead to death in these latter days. Shortly put, he finds that, as

> "by far the greatest part of living matter consists of water,"

water or fluidity of some kind is indispensable for manifestation of vital activity. Now he has shown[2] that under given pressure and high temperature, the elements silicon, selenum, negative sulphur could respectively take the place of carbon, sulphur, and oxygen, while iron might be replaced by copper, zinc, or manganese, and phosphorus or arsenic by that of nitrogen. In the earlier days of our earth and at present in the myriads of vast planets, and white-

[1] "Life and Energy," by W. Hibbert, p. 69.

[2] "Knowledge" for July, 1905.

hot globes, the conditions favourable to the conditions of life may exist. It may be life on a far grander and more extensive scale and living mass utterly different in form and motion to that which obtains on this puny planet; but yet life, reacting, assimilating, growing, secreting, excreting, reproducing. Why, the very phœnix emanating in the flames may not be such a myth after all.

> "The protoplasm of the earth is but the product of evolution of untold æons of ages, coming down to us in an unbroken line from ages when the world was a vast liquid globe of white-hot material. All the elements have circulated in succession through its structure, and then passed out again. First at the highest temperatures came the heaviest and least volatile elements, then as the temperature fell they were gradually eliminated and their places filled by analogous lighter and more volatile elements, until at last living matter assumed its present composition. But this replacement of denser by lighter elements is now almost complete, for the principal elements present in living matter are carbon, nitrogen, oxygen, and hydrogen. And these it will be noticed are among the very lightest non-metallic elements which, so far as we know, exist. No lighter elements, then, can replace those already present in the organism, and therefore, there can be no further *very great* alterations in the temperature of living matter in the coming ages; but the world is still cooling. Consequently, age by age, century by century, the contrast between the temperature of living matter and the temperature of the surrounding medium is becoming more and more accentuated, and the difficulty of maintaining life is steadily increasing. I think, therefore, that so far as the surface of the earth is concerned, organic life is entering into its last stage of evolution.[1]
>
> "Where the external physical conditions as regards temperatue and pressure are such as to render the existence of matter in a fluid or semifluid condition impossible, then life as we know it would be incapable of existing."

The world has cooled and

> "is still cooling and there will surely come a time when the average temperature of the world will sink from its present value (15° C.) to 0° C., to −10° C., −100° C., and finally below the freezing point of hydrogen itself."

The result is that whilst other animals do not drink alcohol the human species do, and do so in ever increasing degree and it

> "will be found that to the maintenance of human energy in a cold climate more alcohol is necessary than in a warm one."

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[1] "Knowledge" for Aug., 1905, p. 195.

When in Switzerland, I found that in the cold, a quantity of alcohol did not affect me that in a warmer climate would undoubtingly have done so. Alcohol only freezes at -130° C. Martin shows that alcohol and water have chemically and physically much in common, that both are mobile fluids, great solvents, and can form crystals; and after drawing many more analogies, comes to the conclusion that alcohol will, in life, take the place of water.

> "Viewed in this light, the phenomenon of alcoholism assumes the greatest interest and importance, as the possible manifestation of a mighty organic change sweeping slowly but irresistibly over the whole of living matter."

The life alcoholic will be short.

It is a passing strange coincidence that in a work of such great antiquity as that mighty Sanscrit epopee, the "Mahabharata," that just before uttering a prophecy as to the ultimate destruction of the world by collision with seven other members of the starry host and its extermination from out the firmament of heaven by the all-devouring fire *Samvartaka*, stand the sentences :[1]

> "Oh King, towards the end of those thousands of years, containing the four *Yugas*, and *when the lives of men become very short, a drought occurs extending for many years, and then, oh Lord of the Earth, men and creatures, endued with small strength and vitality, becoming hungry, die in thousands.*"

And the final picture: Spirits of the air, spirits we see not, we hear not, we feel not.

If glass be very finely triturated, it becomes white and opaque. Melt it into a sheet or pane and it at once assumes transparency. I have often watched a flight of pigeons and noticed that when the sun's rays are impinged at certain angles to the birds, that these become invisible, despite the fact that they may be nearer to me than when visible. So, too, may the carbon and hydrogen of alcohol, other hydrocarbons and so on, take up some isomeric structure perfectly invisible to mortal eye. That insects produce sounds which one cannot detect, save by the aid of some sound-magnifier, is well known. A living creature of the future may produce inaudible sounds, *i.e.* sounds below 20 or above 73,000 vibrations per second. These beings may be yet more intangible than the other. Moreover, by virtue of the elasticity of our universe (*vide* p. 84) they may be possessed of highly elastic properties, be so elastic in fact and the

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[1] From an English translation of the *Vana Parva*, by Pratap Chandra Ray, C.I.E., second edition, 1889, p. 561.

cohesion of their particles be so small, that they may glide into each other without being aware of each other's presence.

When $\frac{2}{5}$ of the substance of the body or 40 % of its weight is lost, comes the nemesis, and there is death, utter and absolute. This nemesis will come to any body, whether it has drunk of the fiery liquid of Phlegethon or of the waters of the ocean, or breathed of the ethereal fluid of the spheres.

But I am not writing a fairy story. These, so children tell me, are going quite out of fashion. Nor am I giving the reader the benefit of some blood-curdling Christmas ghost story. Nor am I a pimp, pandering to the desires of spiritualists financially interested or foolishly believing. Nor am I seeking to lend an apparent plausibility to those absurdities of the highest potentiality, the dogmas of the transmigration and of the incarnation of souls. None of all this. I sought but to make out the outlines of the aerial forms on the horizon before me, to watch their fate, and—well, Mr. Hibbert, all life will cease, and with it your pretty image of ethics, and social life, and moral obligation, and Divine life. I have not, mind you, denied these; but they certainly do not logically follow as a sequence of what we have shown to be the existing tendency. Your well-written and well-meant work is built up on the fallacies that life is a controlling agent, when it is but a condition brought about by a complex union of forces; that life has a tendency to increase, when it is actually on the wane and when the union of the forces aforesaid is about to be dissolved, the aggregate of these (a part of the universe) on the eve of being overcome by the infinite aggregate of the entire; and that mass is indestructible, when it too, like all other forms in the universe, is fugacious, when it is resolvable either into its force components or into isomerisms of these.

One last phase of this question: Will it, during the existence of man on earth, be possible to set up the conditions known as those of "life," in the laboratory?[1]

The little experiments carried out by myself (*vide* pp. 249, 250), the reproduction of salt in fungi, the growing pot (*vide* p. 249), but above all the experimental results obtained by Loeb, Bastian, Burke, and at Karlsruhe, are one and all signs portending a satisfactory solution of this most intricate of intricate problems. The life alcoholic not yet existing, it were easiest to assume that any progressive experiments that may be made, would be carried on on

[1] Compare p. 143.

these lines, since there appears to be a definite proclivity of living matter to assume this or some similar form. Am I an intellectualist? "Time alone will prove all things." The trend of human thought,—who knoweth it? M. Rodin's supreme masterpiece of sculpture,[1] "La Main de Dieu," in which is represented the Divine hand, majestic in conception, full of fine feeling, fashioning out of a clump of rough boulder clay the first pair joined in an act of passionate embrace—this will be a fit and abiding monument in memory of times when men distinguished not between allegory and reality, for the capacity hereunto had failed them.

"*Tempora mutantur, nos et mutamur in illis.*"

Changed are not only we, but our conceptions and our intelligence. Out of eternal and infinite force-forms are warped and woven both the dark dank clay and the pellucid running waters. And these among themselves must perforce commingle and start gyrating, advancing and shooting hither and thither, drawing all around and about them into the giddy whirl.—They live. But not for ever at the expense of others do they live. Retribution in many shapes o'ertakes them, separates them and their progeny after many generations, kills them and they are no more. Not without resistance to ward off the nemesis do their offspring die, but seek with intellect sublime to perpetuate themselves, to longer live in loose concourse, in bubbling, frothy selfishness.

Is our nescience less? Who is there mighty enough to transpierce with intellectual lance e'en the pellicle that separates to-day from to-morrow? But sounds reach my ear, the words of to-morrow's sages, and these seem to say:

Mankind, strive thy best:
So shalt thou find
Omne vivum non
E vivo est.

One thing is certain, and that is, that after a thorough digest of the foregoing chapter, one is gradually brought to think that the perigraphic cathedra utterances regarding the scientific aspects of the life problem,—cunningly nurtured in a culture of loosely kneaded perisology more apposite to quacks, cheap jacks and charlatans, than to men of profound erudition—are not so much the result, either of the mental myopy or religious fanaticism of theologians, as of a purposeful afforestation, on their part, of equivocations, the dark-

[1] Exhibited in 1905 in the central hall of the New Gallery, London.

nesses of which will effectually, they hope, cut off from their audiences the view of the grand scenery, on which you, dear readers, have just been able to fix your raptured gaze.

Be no nutant hearer of the vain cavilling of nuzzling ecclesiastics; but put their words in the scales, weigh,—and you will find them wanting. This exercise will strengthen and cure you once and for aye of any possibly residual mental anæmia.

CHAPTER II

INTELLIGENCE

> "The mind is its own place, and of itself
> Can make a heaven of hell—a hell of heaven."
>
> MILTON.

WHAT can we see?

A refreshing breeze is blowing. In the sharp crisp atmosphere our breathing comes short and quick. The environment is clear and dry, but rare. Far, very far off, rising from out fathomless space, towering into an infinitely high firmament, and stretching out continuously right across the entire breadth of the on both sides endless horizon, moves,—sometimes slowly, sometimes so rapidly as to make its exact action indiscernible—the mystic primordial force. Weird is the scene nigh beyond description, surpassing in its strangeness, stupendousness and enormousness, the scenes of Mount Olympus, of Walhalla, or of any of the most fantastic dreams and uncouth visions ever depicted by mortal.

Due to the ever varying velocity and kind of its motions, many are the forms that this force assumes. Yet so far back in the remote ages do some of these force-forms lie, that their origin is lost in darkest oblivion, and their purpose will probably remain for ever inscrutable; but their past is nevertheless intimately and inextricably interwoven with the present. They unite and interlace, making other forms marvellous to behold. One group especially holds our attention fixed—it is that of centripetally whirling nebulæ, —it is matter.

With bated breath, we watched the course of now rapidly seried events. The phenomena increase more and more in complexity. The glare is lurid. Seriate appear, one after the other, various coalitions of materialised force-forms—the elements. Ever increasing heterogeneity produces from these, the compounds; which again, under the influence of other force combinations, affect forms having

specific characteristics to which we have in the last chapter learned to give the collective epithet of "living." Water devours the flames; the environment hardens and cools; plants swim about and then take root; others maintain their nomadic habits and in time become animals; and lastly, close below us, animals are developing, and after vicissitudes too numerous to relate, are taking the shape and nature of primitive man, of the giant man of the stone ages, an indweller of caves (the Jehovist), or of the smaller man, finding a resting place in the boughs of trees (the Adamite), in both cases quite different to ourselves, but yet men. And from these men, or a cross between the two, are we ourselves in long line descended.

Turning round, we see on the other side of us gossamer shapes, aeriform creatures, hovering, flitting,—and then these disentangle themselves from the meshes of substance and return to states not the same, but comparable to those of primordial force (as we know it), and then—and then? The rest is lost in a future as inscrutable as the past.

What contrasts and divergences! Simple forces—dead mass—living beings—ethereal existences! A coming into, a going out of existence! An awakening to life, a giving birth, and a dying! Yet all these, one and all, various vicissitudes of one and the same force! Can I be seeing aright, or am I labouring under a delusion? Am I awake, or am I dreaming? Is that before me a reality or an illusion?

What is a reality?

I have given two definitions hereof, one on p. 23, the other on p. 62. Although apparently, they are not really contradictory, and the latter may rightly be considered as supplementary and complemental to the former. Both are correct. Circumstances compelled me at a very early stage to give a definition, and such definition could only be given in the light of already obtained knowledge, which was scant; and the second exposition was moreover intended to document an advanced stage of thought. From all the evidence now before me, I am bound to conceive of an absolute infinite reality, ἐνέργεια, the actual, of the nature of an all-pervading force taking endless forms, of which I am forced to deduce that certain forms, to which I have given the name of primal forces (which are actually no more primordial than any other form), existed, and that these have changed and combined in long series, till they have assumed the complexity of mankind and therefore of myself. At this moment I feel infinite force and myself as a part of it.

(Vide definition p 63)

These force-forms are abstract realities. By the abstract realities before me, by the aspects by which I am, at this juncture, bounden to conceive of the veritable realities—the true force-forms—I am compelled to deduce that the abstract realities in my view, primal forces, inorganic and organic, dead and live matter are links in one infinite unbroken chain of changes that have taken place. The changes which I have deduced to have taken place are not illusions but probabilities, for in many cases, nearly similar realities exist now.

Anaxagoras (B.C. 500—B.C. 428) did not perhaps, like Leeuwenhoek, see the imaginary homunculus in the sperm or the life-giving and hereditary germ, but he imagined something yet more remarkable, and fancied he saw or conceived of each kind of matter existing independently, but diffused through unlimited space, in infinitely small particles of itself in infinite number, but yet inextricably mixed up with particles of other sorts of matter. The diffused particles of any one kind were afterwards collected to one whole, but this whole also contained some few particles of other substances, no one stuff was unalloyed. This is really tantamount to saying that it is improbable that Aristotle's ὁμοιομερῆ existed: only ἀνομοιομερῆ had a real being, but that the collected article was more homogeneous than the diffused mass whence its origin, that greater homogeneity was an advance on greater heterogeneity, a notion which, compared with Spencer's, shows that *the terms homogeneous and heterogeneous are relative expressions only*, varying in meaning according to the aspect from which they are approached. (p 25-6)

It is interesting to note that Anaxagoras, like ourselves, came to the conclusion that homogeneity cannot be; but his idea is founded on the probable misconception of each kind of mass existing from all eternity, whereas we have learned to know that every matter is a state of that before it, and that such state is not durable but eternally mutable. That no matter exists without admixture, in small degree, of other matters is very like our conception that no element is actually indivisible or even that every force is an effect, itself a resultant of two or more component forces which are the causes. Old Anaxagoras conceives of an illimitable, all knowledge-possessing, independent, yet with mass co-existent, intelligent, subtle ether, to which he gives the name of νοῦς (Intelligence) and so comes very near the modern Prof. Haeckel when he finds, co-existent with matter, a mind or sensation-cognisant ether.

The νοῦς, according to Anaxagoras, appeared first as a very rapid

rotary movement, drawing each substance unto itself. Is this not very similar to our own idea that centripetal forces whirled nebulæ into being out of primal forces, and worlds out of nebulæ? Is it not analogous with our notions of atoms and electrons? In fact, the only manifestation of reason, says Anaxagoras, is motion. That all is force, that force is the producer of motion, and that force and therefore motion ever was and ever will be is nigh the same. The two are however not identical. On what grounds does Anaxagoras base his conclusions that motion is reasonable? Because he sees purpose in nature? Haeckel conceives a sensitive semi-conscious ether, and yet he, contrary to Anaxagoras, sees no purpose in nature. Are these two men, separated in time by over twenty-three centuries, intuitively right, though basing their deductions on false hypotheses, or are they both in error?

Let us try and form a judgment of our own, based on the knowledge we hath hitherto gleaned, a knowledge founded on insight into causes—*vere scire est per causas scire*—and this through the medium of the senses. This is all that is possible. We exist and our senses exist: they are veritable realities, but we know them as abstract realities only. In this sense, we know that we are capable of accognising, of recognising: we have intelligence. Is this intelligence a characteristic of ourselves or of a part of ourselves, or is it, as was till comparatively recently supposed by all and even now by a great many, an individual intellectual soul within us? Is intelligence confined to ourselves, or do we possess it in common with the brute, or is it even πρότερον φύσει (prior or *à priori* to nature), an intelligent existence (ἐντελέχεια) which, pervading all space, brought nature into existence and still rules it; or have we no intelligence of our own, but are forced to accognise, to recognise, to deduce, to have a notion of, to conceive things according to the force and forethought of this mighty or infinite subtle all-penetrating ἐντελέχεια; or lastly to be perfectly fair and to treat the subject on as broad a basis as admissible, is all intelligence, is everything, thought and existence itself (as far as force and motion are concerned) non-existent?

The existence of a bodily form, of an intellect governing it, of electrons of which the bodily form is composed, and finally of the forces in eternal motion which go to build up these electronic shapes and which themselves will revert to primal forces, would one and all in this last case be imagined only and the sole absolute reality, the ἐνέργεια, would be ἐντελέχεια.

That this is however not so, the following few observations will suffice to show.

"Will" exists, says Schopenhauer, but nothing else save "Will." This conception of his cannot be true, for thought exists, I must think (*vide* pp. 39, 40). It were impossible to will to think, if there were no thinking organism capable of thinking. Willing something and conceiving something are two totally different things, although by employing the organism, the Will might be able to will a given thought. Then Will and the thinkable mechanism would be co-existent.

But cannot thinking be carried on without a governing will? Cannot, in fact, Intelligence conceive "Will," conceive a force governing itself without actually being so governed? Might not this "Intelligence" be an organism, but apart from the parts of this organism there be nought else existent? There is deduction and the logical sequence of ideas, but might not logical sequence or order be an attribute of "Intelligence" requiring no force to make it think in any one special direction?

I am thinking now about my own thoughts, brooding whence my thoughts arise. This, one might say, is a proof that this suppositionary thinking-force coalition is arbitrary and erratic in its functions, a very probable attribute of a self-governing body and making yet more plausible that this organisation was alone in being. To me it is a very substantial piece of evidence that I feel that my thoughts have an origin. I most decidedly do not feel independent in thought. I feel there is something beyond me whence my thoughts arise. There is therefore at least duality, thought and a source of thought.

Again, a perpetual logical sequence of thoughts means continuous action: But if there is continuous logical thought everywhere, there cannot simultaneously be force to keep this thinking constantly a-going, and hence it would at last cease and not be continuous, a statement which is self-contradictory and absurd. Therefore a force must exist to keep the organisation thinking. Invent a force to keep this force in order, and we are juggling much in the same manner as was once done with the ether series.

We therefore have now come to the definite conclusion that there is an existence—our existence—independent of our thought of it—independent of the thought of it. *Thus intelligence cannot pervade all space as a force* ***a priori*** *to nature, bringing nature into existence, since there are natural forces independent of it, precluding its omnipresence.*

It is true that

> "If the nerve of sight is pressed, the patient believes that he sees a light external to his body."[1]

That is to say, no exterior influence giving us light, produced in the patient a sensation of light. But it was an exterior influence that pressed the nerve of sight, and usage (the mental record) having nought but light waves as the optic irritant and exterior application to fall back on, he calls the applied pressure exterior light. It is probable that every stimulation of the optic nerve-cell, whatsoever its nature, would produce a sensation of light.

> "Wherever the excitement occurs, whether in the nerve-cells themselves or anywhere in the course of the nerves leading to the cells, consciousness always refers the sensation to the presence of some external cause of excitement."[2]
>
> "Our power of conception always projects every sensation which reaches the consciousness outward, that is, to where the cause of the excitement is normally."[3]

It is in this wise that we have our conception of exterior environment.

There is therefore no infinite force of Intelligence.

Neither can Intelligence be an attribute of infinite force; *for to conceive of heat, light, sound, cohesion, gravity, and so on being intelligent were absurd, for the reason that we have shown that no matter and no other force-form can infinitely break up and yet maintain its attributes.*

When the force-combination matter breaks up into non-material forces, each of these non-material force-forms cannot have the attributes of the original compound. Even a gas does not possess the adjuncts of the solid whence it came. In like wise where the living brain dies and decomposes, the products of decomposition cannot have the nature of the complex brain. Intelligence is therefore not only no endless force, it is not even a perpetual attribute of force.

The order of this universe, the mechanism of the world, the destiny of man is not therefore thought out in advance.

Our thoughts are not ancillary to an infinite omniscient existence, although our every thought and act is forced upon us by our

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[1] "Physiology of Muscles and Nerves," p. 279, by Prof. Dr. I. Rosenthal; pub. Kegan Paul, Trench, Trübner & Co., London, 1895.

[2] *Ibid.*

[3] *Ibid.*, p. 280.

environment, for the force of thought—force alone is—is part and parcel of and therefore influenced by the entire. Everything (as we have seen in Bk I Chap. IV) has its purpose; but not for a purpose was, is, or will be any force premeditatively set a-going—*it serves a purpose, but not purposely does it act.* Please note this most important distinction, one to which we shall have to revert anon. (compare p 210 as to purpose in sa

The next tasks we have to set ourselves are to trace the seat or seats of intelligence and to define the same.

The brain is evidently a seat of intelligence, for every physiologist and psychologist will be able to tell you of his experiments with the brain. But the brain has many parts. It is in part most probably the greatest current supplier or of ingredients for making the battery, whilst the nerve-cells have each their own specific reactions. These again depend on the organs of sense. A beautiful account of the nerve currents, and of the attendant phenomenon of electrotonus, is given by Prof. Rosenthal, to whose work (*vide* footnote [1] on p. 270) I with but very few reservations refer the reader. Nearly all these senses have been located. That is to say, he can fairly define the limits of the various parts of this structure within which the brain receives and accognises and acts specifically to the irritations or excitations of sound, light, taste, smell, and so on. He (the physiologist) can remove the nerve-cells of sight, of taste, and the like more, and thus bring about a want of the respective sense. Prof. Edinger [1] informs us that fishes have no brain nor even the cortex or membrane of one, and yet they feel, and on feeling an irritation which to them is unknown or unpleasant they scud away. On the other hand, I have myself trained goldfish to expect food when I whistled, and to come for food to that side of the bowl from which they heard or more probably felt the whistling to proceed. The fish had a sense of location and could act on it to a purpose,[2] which proves the existence in them of intelligence.

There are, however, in connection with the brain—and in fish even without brain—a spinal cord, ganglia, nerves and sense-cells. The spinal chord and ganglia are of a similar material to the brain and like it contain a greyish and whitish substance. As I hinted at an earlier stage (*vide* p. 100) even in man, many an action on the

[1] That boned fishes have no brain-cortex was first casually noticed by Rabl Rückhardt, but the main study has been undertaken by Prof. Edinger. For an exact account of the researches on this subject, *vide* "Beiträge zur vergl. Anatomie," by Prof. L. Edinger, which has, since 1887, appeared by M. Diesterweg, Frankfort a/M, in five sections. See also the pamphlet "Haben Fische ein Gedächtniss," by Prof. Edinger, being a reprint from the Beilage zur "Algemeinen Zeitung," No. 241, 243, of Oct. 21st and 23rd, 1889, Munich.

2 But not purposely

body is the result of recognition of sense by the ganglia and does not necessarily pass *viâ* the nerves to the brain at all. But perhaps one of the most prominent examples of this kind is that a certain degree of consciousness can be retained by a man in which the connection with the brain has been severed. Thus, a man with a broken back passes water and the motions consciously, a fact due to the working of the cells in the spinal cord below the point of rupture. The cognition and may be the acts of fishes is probably the result of forces at work within the ganglia and spinal cord. In Hydra even "Sense-cells appear to be wanting,[1] but they have ganglionic cells," says Prof. Rolleston. These ganglionic cells may here do the double work of receiving and acting accordingly, for the Hydra go into shady places in breeding time; but it is more likely due to a combined working of phototropism or/and thermotropism and reflex actions only, a series of purely mechanical movements brought about by environmental physical and chemical action without any interior processes.

We have no direct proof of feeling, of an intelligent cognition of an excitation, *i.e.* an irritation. We cannot in every instance say that where there is an action in accordance with an excitation that there is therefore intelligence. And here I must modify an earlier statement of mine (*vide* pp. 176-180). As nothing inorganic has intelligence it cannot have an irritation, but only an excitation. By an excitation, it receives motion—the motion due to stimulæ, just the same as a plant or animal—but as it has no intelligence it cannot be irritated.[2] Plants cannot be irritated, nor even some animals. They, like inorganic mass, having no intelligence, can only be excited. The amœba assimilates food each time it comes into contact with it, but there are no grounds for supposing that the amœba feels the food, *i.e.* intelligently accognises the presence of nutriment and accordingly assimilates it.

Intelligence seems confined to living matter possessing ganglionic matter and nerve or/and brain (a cerebral system). Where these do not exist, intelligence cannot be. The nervous system arises from the ectoderm; but I see no reason for assuming that the ectoderm *per se* had intelligence either before it evolved nervous structure or after, or that the nerves or nerve-cells have intelligence

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[1] *Vide* "Forms of Animal Life," p. 328, by Prof. George Rolleston; pub. Clarendon Press, Oxford, 1888.

[2] *Vide* my definition of an irritation, p. 14.

apart from the ganglia or/and brain. What Haeckel finds[1] requisite for consciousness, I find necessary for intelligence: a centralisation of the nervous system, *i.e.* the presence of a nervous central organ and highly evolved organs of sense in connection with these. Without these there can be no intelligence. Criticising in a similar strain, Sir Oliver Lodge sarcastically puts into the mouth of Haeckel the remark[2] that because a path serves a purpose

> "whatever knowledge or purpose the path exhibits must be in the *path*, must be a property of the atoms of which it is composed. To them some fraction of will, of power, of knowledge, of feeling *may* perhaps be exhibited."

Even the Tibetan has some faint idea that intelligence lies in the brain, for when he dies, a Lama makes a slit in his skull and leaves the body in the dead man's chamber for three days to let the soul pass out, prior to the corpse being carried to the accompaniment of conch-shell music to the ceremonial stone at Wethan, which forms Atisa's tomb, and where it is cut in pieces and distributed to dogs and vultures according to Buddha's behest to benefit all creatures.[3] The Hebrew found a dishonour in leaving his human remains to the beast of the field and the fowl of the air, the Tibetan finds therein an honour.

One often hears in quasi-scientific circles and even in a certain coterie of genuine scientists the following strange kind of argument: Man acts in a given way with a given result, hence to man is granted either will, consciousness, or intelligence, as the case may be: animals act the same, thusly they have a will, consciousness or intelligence; plants similarly, consequently to them must be ascribed the possession of a will, consciousness or intelligence; and lastly, in the long series of descent, the functions of inorganic matter are analogous, *ergo*, to inorganic matter belongs a will, consciousness or intelligence. As long as there have, in two or more sets of objects, actions taken place in like wise, *i.e.* the effects being apparently the same, to both of these sets appertain the same adjuncts. What argument could be more fallacious! Is it not curious that the idea cannot be grasped, that several causes produce a similar effect? (*Vide* pp. 98-100.) They do not, of course, produce the same effect. Although a pendulum in two instances swings from

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[1] "Die Welträthsel," p. 72.

[2] 'Mind and Matter' in the "Hibbert Journal" for Jan., 1905, being a Presidential Address to the Birmingham and Midland Institute.

[3] *Vide* art. 'The Feast of Death,' by Edmund Candler, in the "Daily Mail" for Sept. 21st, 1904.

side to side (two similar effects) it can be attracted to each side in turn in the one instance and repulsed from each side in the other (it is not the same effect). My hand lifts a weight, and from this is deduced that I possess a will. A steel magnet raises iron filings, and so Prof. Carl Pearson would award a will to the iron magnet. Yet more, he apparently admits the possession of a will to all the conceivable primeval forces[1] of the universe. It is in this strain that several scientists would ascribe conscious action to the movements of plants of the fly-catcher type, in that it feels the contact of the insect and thereupon closes on it. This action would however appear to be simply of the nature of a reflex and the result of fluids being excreted through an electric current being set up by the excitation of the fly. In the *Dionœa muscipula* (which moves like *Mimosa pudica*)

> "glandular organs occur which secrete juices capable of digesting albuminous bodies.[2] . . . . When an insect touches the leaf, the halves of the leaf close on each other, and the imprisoned insect is digested and absorbed by the secreted juice. In judging of the nature of these leaf movements, it is necessary to decide whether they are really analogous to muscle-movements, and whether the identity extends even to the electric phenomena, as Burdon-Sanderson would have us believe. Recent researches by Professor Munk of Berlin have not confirmed this. The movement of the leaf of the *Dionœa* must be regarded as entirely similar to those of the *Mimosa pudica*. These movements are dependent, not on contractions, as are those of muscle, but on curvatures which occur in the leaf in consequence of the alteration in the supply of moisture in the different cell-strata. The leaf does indeed exercise electric action, though not in the simple way claimed by Burdon-Sanderson. Changes in the electric action also occur during the curvature, but these changes do not correspond with negative variation in the nerve-current; they are probably connected with the circulation of the sap within the leaf."[3]

Where these phenomena are so absolutely different from those which go on in glands, nerves, and muscles, it were hard to conceive the presence of any form of conscious sensation or intelligence.

In tackling such questions, Prof. Haeckel shows himself more guarded, yet the system of argument is practically the same. He is however not so perspicuous and at times seems to forget his own standpoint. In trying to draw a hard and fast line between soul and

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[1] *Vide* footnote to p. 73.

[2] "On Insectivorous Plants," by Darwin, London, 1875.

[3] "Physiology of Muscles and Nerves," pp. 224-225.

consciousness ("Seele" und "Bewustsein"), which distinction of his Du Bois-Reymond could not make out and was therefore, poor man, subjected to the former's ire,[1] Haeckel fails utterly. Those of my readers who have not read Haeckel, may not be able to see what 'soul' has to do with the subject at issue. Haeckel's 'soul' is not the soul of the theologian: it is the intelligence of living matter. Psychology is that science which determines the nature of mental phenomena and classifies them, and Haeckel calls psychology "die wirklich wissenschaftliche Seelenlehre[2] (Engl.: the really scientific science of the soul), the brain "das wichtigste Organ des Seelenlebens[3] (Engl.: the most important organ of the soul's life), and the soul itself a natural appearance. In discussing Haeckel's soul, we are treating of intelligence. His psychoplasm is the *νοῦς* of Anaxagoras, limited to living matter: but his statements regarding psychoplasm are as dogmatic and void of proof as the theologian's hypothetic soul. We have no proofs of the existence of this substance. It is not even the liquid or fluid which fills the hollow or ventricle of the brain which is mentioned by S. T. Sömmerling in his "Das Organ der Seele" (pub. Königsberg, 1787?) as being the seat of the 'Sensorium commune' or combined intelligence and consciousness.

Not allegorically, but with distinct intention to use his own words literally, Haeckel writes of the 'efforts at self-preservation (Germ.: "Streben nach Selbsterhaltung)[4] of unicellular protophytes and the lowest animals. How can these exert effort, *i.e.* work intelligently towards a given goal, that of prolonging their lives? This would involve a very high grade of intelligence indeed. He mentions not only their excitability (Reizbarkeit) but their irritability (Empfindlichkeit), as if they could intelligently cognise change of motion. Because of their acting in certain ways on being excited (acted on), due to physiological processes going on in the plasma of their cells, caused by "physikalische und chemische Veränderungen, welche theils auf Vererbung, theils auf Anpassung zurückzuführen sind."[5] (Engl.: physical and chemical changes which are brought about partly through heredity and partly by adaptability), Haeckel assumes that these actions were wittingly carried out and that the changes that took place in these bodies by means of which they became more

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[1] Haeckel's "Welträthsel," p. 73.

[2] *Ibid.*, p. 39.

[3] *Ibid.*

[4] *Ibid.*, p. 40.

[5] *Ibid.*, p. 40.

suited to their surroundings owed their existence to the fact that these primeval monads purposely changed their condition and state of being, to adapt themselves to the environment—quite a gratuitous assumption. He takes for granted that the early algæ chose food which they could easily digest, just as we might say, "cucumber is bad at night-time, let us take something else more easily assimilatable so as to give our bodies the opportunity of exerting all their energy in carrying on the growth which we know takes place chiefly at night-time."

Tropism—the tendency to act on a given excitation[1] (which is quite unintelligent)—is a physical function carried out equally by dead and living matter, and is not limited, as Haeckel would have it, to plasm. There is evidently a tropism in the mineral sodalite to become pink in the dark (*vide* p. 81). A bar of iron expands on being heated. There is the tendency of each ion to separate from its neighbouring ion. There is tropism in a so-called compensation clock or watch. The mechanism, when once put together, has a tendency to act on the excitation of warmth. The expansion of the two metals in the pendulum or spring regulates the movements of the time-keeper, and for a given temperature, the entire nature of the structure is always the same. I can construct a lever, so near to a metal bar, that on a certain amount of heat being applied to the bar, the said lever is at once raised or lowered as the case may be. There is in such collective adjustment a clear tendency to act on a given excitation. Would Haeckel say that because he here found that the lever adapted itself to its environment, that therefore such adaptation was purposeful on the part of some ethereal substance in the material of the lever? But this is exactly the same sort of thing that takes place when the tentacles of a primitive animal having no mouth move in the same way as the tentacles of the anemone which has one,[2] or when parts of the plant known as a 'fly-catcher' traps its prey, or when the proboscis of a bee absorbs honey on being brought into contact with the same even when it has been perfectly severed from the rest of the bee's body.

Remove from man his entire brain, and he dies. True it is that the ganglia act independently, but their action is insufficient to keep the vital organs going. Although, as we saw on p. 272, there is a slight consciousness for a short duration without brain, yet without

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[1] Excitation but not irritation, as we now see wrongly defined in footnote [2], p. 23.

[2] *Vide* footnote [2], p. 23.

either brain or ganglia, or by a complete severance of the connecting nerves, man loses all power of acting purposefully to a given irritation, although, as has been already observed, nerves and muscles can react on being excited even after death. Haeckel only judges of intelligence by the movement which he sees. On the other hand, the other extreme is just as much to be avoided. We are too prone to find a lack of intelligence where, in response to a given stimulation, there is not that action which we are wont to see in others similarly excited. This is rather arbitrary and is no doubt in many instances fallacious. I see no cause why there should not be an intelligent cognition of a sudden or unaccustomed movement despite the fact that there be no purposeful action in response to such stimulation. As a matter of fact, experiments have been carried out with monkeys which seem to point to quite an opposite conclusion. On April 28th, 1905, at the International Congress of Psychology, Prof. Sciamanna exhibited a male and a female monkey, both alive, from which the right and left lobes of the brain had been extracted. Although, as may have been expected, the movements of their limbs had been affected, their habits, or as the Professor described it, their personality, which had previously been very studiously observed, had undergone no variation. Their intellect appeared unimpaired.

To repeat: with man as with all animals possessing a cerebral system, a complete destruction of such system is productive of the destruction of life of the entire. There is no longer not only any action but any phase or phenomena which would indicate that there existed a cognition of the environment. It is to us inconceivable. Why then assume it? There must be herein, as in all else, no dogmatism.

But, conversely, it cannot be asserted that all the actions, even of man, let alone of animals possessing such a cerebral system generally, are intelligent. There is much more reason for believing that very many actions are due to purely physico-chemical agency. Professor Haeckel does not appear to be acquainted with the recent work done by his eminent German colleague, Prof. Edinger,[1] wherein the latter at all events shows what actions can be considered as of a purely mechanical nature without having to credit the actor with any powers of intelligence or/and consciousness. It was, I believe, Meynert who once said,

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[1] *Vide* "Hirnanatomie und Psychologie," by Prof. Edinger; pub. Aug. Hirschwald, Berlin, 1900.

"Eine Vielheit der bestimmenden Motive bewegt uns in der Annahme eines bewussten Willens; einfache und eindeutig bestimmende motive lassen uns auf einen vorgebildeten Mechanismus schliessen."

"A number of determinative motives leads us to accept a conscious will; simple and in one sense determinative motives let us conclude the existence of a pre-constructed mechanism."

There are certain actions, well described by Engelmann, Verworn and Löb, which under similar conditions can always be relied upon to take place with regularity as soon as the excitation is the same or similar. Such are termed, as we have learned, tropisms, of which there are quite a number, such as thermotropism, heliotropism, electrotropism, chemotropism, geotropism, and the like more, and which are of exactly of the same nature as those noticed by Pfeffer in plants.

Several plants possess the capacity of ejecting given substances whilst, on the other hand, it is now known that certain chemical bodies have the power of directly attracting vegetable germs and lower animals to them. This attraction of substances for each other, which has its origin in inorganic chemical affinity as seen in such a simple case as that of sulphur for iron, accounts for the animalcule Vampyrella picking out the Spirogyra from out a whole host of algæ within which to bore itself. The Spirogyra has certain chemical compounds which attract the Vampyrella. It is no doubt a similar cause, which attracts the fluke (*Fasciola hepatica*) to the snail *Limnæus truncatulus* (*vide* p. 234). The act of erection in animals and in man is probably the result of such attraction, no two animals or persons having exactly the selfsame excretions and pigments, and therefore that being which is attracted by the one is not necessarily attracted by the other. In animals, this force is known as animal magnetism. Of course, in man and most likely in the higher brutes, unconscious association of feelings may do much. Thus, a person in effluvia, appearance, or/and voice similar to the one possessing the attractive substance, may set in action the erecting mechanism. The action is here more complicated but not necessarily intelligent.

There are very many more such actions which formerly were only explainable on the hypothesis of the existence of a psychic medium which are now very easily mechanically elucidatable.

I mentioned on p. 276, that the proboscis of the bee is brought to perform the movements of sucking by the simple chemical

excitation of honey and the current set up (of whatever nature they be), and this current takes up a given line or route—the reflex circle. Therefore when a bee is taking its food, it is no more necessary to think it is hungry, than to assume the appetite of an amœba (*vide* p. 272) when it flows round and assimilates certain substances to the exclusion of others, for Rumblex made artificial amœba with a mixture of chloroform drops and other matters, which, when brought together with chemical matters of suitable nature, acted in just the same way. Moreover these chloroform bodies took up grains of quartz and built thereof habitations much of a wise as the primitive animal. It is most likely that regular hexagonal sections of the comb cells of bees are also formed as the result of environmental excitation. Here, however, it is not unlikely that there are two other causes: the fact that circles when slightly but uniformly pressed together, assume a hexagonal contour, and that there may be in the bee a certain amount of inherited tendency to construct regular shapes after the manner of so many of the lowest animals, radiolaria and the like more. Prof. Haeckel writes of the efforts toward self-preservation (Streben nach Selbsterhaltung). Wherein is such an effort to be seen, when the sting of a bee can be excited to sting when separated from the body? Bethe has succeeded on the crab *Carcinus mænas* and Löb on other crabs and some worms to produce by artificial stimulation nearly if not all the actions which they bring about in the usual way. Worms can be made to go through the action of boring holes without anything to bore through. Von Uexküll has found that the entire surface of the sea-urchin is covered with the most diverse organs which work quite independently of any central system by the exterior excitation of which it can be made to attract food, to clean itself and to move from place to place.

A similar course of study brought Prof. Meynert of Vienna a name by his locating the power of the will, *i.e.* the power by which at will, the muscles are made to move, in the frontal lobe. This last is still open to doubt, unless indeed the frontal lobe be the main seat of consciousness—a hypothesis against which more can be urged than can be brought forward in support of it. The experiment of Prof. Sciamanna must in this connection not be forgotten (*vide* p. 277). Be this as it may, by tracing the same footsteps as Meynert, the well-known physiologist H. Munk has indisputably demonstrated experimentally that the brain cortex of monkeys is the accumulator station for setting all the machinery of the monkey

system going. Munk observed that even after the removal of the entire brain organ proper, that the monkeys so experimented on, showed not the slightest vestige of idiocy. The seat of intelligence would lie diffused over the entire cortex of the brain. In the case of fishes without such brain cortex, their rudimentary intelligence would be seated in the cortex of the ganglia. Following a like train of thought, the human intelligence would be diffused over the whole ganglionic and brain cortex. The more folds of the brain, the greater its surface, the greater the cortical surface. Thus the brains of the great physicists Profs. Helmholz and Per Adam Siljeström (this last examined by Prof. Retzius), as of Hugo Gylden the astronomer, and the mathematician Miss Sonja Kowalewska all possessed an abundance of convolutions, *i.e.* a vast cortical surface, especially in the forehead and temple regions. Two last examples of this kind. Experiments carried out by Goltz have shown that at the breeding time, a frog embraces its mate not lovingly but mechanically. There may or may not be feeling from the process. Most likely there is, and this feeling is probably inheritable. There grows an inherited tendency in the offspring and those beings evolved from frogs to produce a similar action to that which produced the original sensation. Be this as it may, the fact remains, that at copulation time the skin of both male and female, even of the dead, is able to set such a reflex motion in action, when touched with the webbed feet of the frog, that the front legs tightly embrace.[1] This action is confined to the marrow of the neck and the two arms, for a similar action takes place when the ring thus formed is separated from the rest of the animal; so that it is here no good assuming that there is consciousness in the marrow, for the procedure goes on by mechanical application and when there is nothing to be embraced.

A remnant of the reflex action is still to be seen in man. After erection, there is a distinct sensation to embrace, a tendency which we have, at Society's behest, to control. This environment of conventionalism, and the knowledge which has been brought us by civilisation as well as its idleness and luxuries which are both not possessed by the frog, are other causes of decreasing reproductiveness.

The Siamese keep fighting fishes after the manner of the old English fighting cocks, and the taxed permission to hold such

[1] *Vide* art. 'Hirnanatomie und Psychologie,' by Eduard Sokal, in the "Berliner Tageblatt" for April 29th, 1901.

animals brings the Government a very acceptable addition to its yearly income. The Anamese have a similar custom, and so excited do they get over such events that they wager not only money but their wives, their children, and themselves. These fish are of a species which I have not been able to ascertain, but are about as thick as the finger of a little child and about two inches long, and are kept by the Anamese in separate bottles which are never together, so as to prevent the fishes seeing each other, or else the fishes become excessively restless. So great is the fighting propensity or proclivity, that if a fish-containing vessel be held up in front of a mirror, the fish will at once "go for" its reflection. This fighting action, although apparently one of hate, is also probably caused by a reflex movement originating in light of a given power or shape moving in a given way so as to excite special nerves.

The very fact of a person being hypnotised and carrying out the suggestions of the operator shows that the subject has lost his intelligence—once thought divine—and is regulated in his actions, even as regards his breathing, by the intelligence of another. Where is the intelligence of the one operated on ?

The foregoing example of fish fighting shows us that the fish have no instinct. If they had had instinct, they would not so wildly have thrown themselves to their own hurt against the glass of the bottle. Wild animals, wolves, foxes, and so on, when strongly caged, hurl themselves against the iron bars till internal, external injuries, or loss of blood kills them. Birds too have been known (especially chaffinches and bullfinches) to flap their wings against their cages to the sacrifice of their lives.[1] The "Daily Mail" for August 8th, 1905, narrates of a cat at Whaplode in Lincoln that was contentedly suckling three wild rabbits ; whilst the same paper of May 22nd, 1906, makes mention of a cat that harboured a young chicken. Similar cases of hens with ducks, dogs with rabbits, are numerous. A sparrow at Northampton, says the same number of the said journal, built her nest in the leaves of a broccoli plant. Did she not instinctively feel that the plant might be cut down by man ? When the casarita takes a thin brick wall for a cliff (*vide* p. 108), where is her instinct ? Malthus,[2] quoting from Cook's "Second Voyage," vol. ii., p. 187, writes of

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[1] *Vide* an art. in the "Daily Mail," 'Can Animals commit Suicide ?' 1905-6 (exact date forgotten).

[2] *Vide* the "Essay on the Principle of Population," by T. R. Malthus ; pub. Reeves & Turner, London, 1888.

> "The wretched inhabitants of Tierra del Fuego whose very appearance indicates them to be half-starved and who, shivering with cold, and covered with filthy vermin, live in one of the most inhospitable climates in the world, *without having sagacity enough to provide themselves* with such conveniences as might mitigate its servitude and render life in some measure more suitable."

Malthus, in another place, refers to Symes's "Embassy to Ava," chap. i., p. 129, and "Asiatic Researches," vol. iv., p. 401, wherein mention is made of the inhabitants of the Andaman Isles who literally starve. Are they not wanting both in reason and instinct to live there? where is here Haeckel's tendency to self-preservation? There are those who have illogically reasoned that long fasting is beneficial to the health, and carry their absurd ideas out to their own destruction. Only comparatively recently, a Mr. G. Heald, of East Wilton, to benefit his general constitution, fasted from June 2nd to July 30th, 1905, when he died, a victim to his own reason. Till within a day or so of his death, he said he believed the fasting was doing him good. When a man tears out his hair in a frenzy of anger or grief, or ruins his health with drugs—where is the Godly instinct?

There is yet another aspect of the case. When one sneezes in the morning, is that sneezing due to an irritation of the mucous membrane or of the ocular nerves? (*vide* pp. 13 and 99). Where is here the divine instinct in man to aid him in the choice of a remedy? When vomiting occurs (*vide* p. 100), how is one at once instinctively to know the cause so as to find the cure? When the nerves at one's back are so few (*vide* p. 13), or when, as has been observed in *tabes dorsualis*, there is the condition of polyæsthesia in which there is a sensation of two or even several points when only one single point on the skin has been stimulated, so that one does not at once accognise the point of contact in order immediately to protect the spot affected, where pray does instinct come in? It will doubtless be urged, that man requires no instinct, for he has divine intelligence to reason. The possession of reason is, in the above instances, worse than the possession of instinct, and man would be worse off than the animal with its suppositionary instinct, for human reason is bound to be faulty.

Or will some one say that human reason is never faulty, that if a human being have erred in his judgment, it was intended that he should err? To this I make reply, ~~that~~ but there being no intelligence in aught except in that possessing a cerebral system there can be no intent.' Moreover, to suppose an 'intent' in the universe outside

ourselves, were a preposterous proposition, too outrageous to be harboured for an instant. To purposely place a person in the world to err and then, as the Church would have us taught, to punish us for sin we could not help—where were deity? Or is the deity so unintelligent that it puts machinery in motion, which once set agoing, is lost to its control? Is the intelligence of man, formed by a deity, so great, that it exerts a will—a so-called free-will for right or wrong—to thwart the actions of that which intelligently put it into action? If the deity is suposed to give a man free-will, how is it that another man can rob the first by mechanical, persuasive, or hypnotic force of that free-will and therefore undo all the deity intended? Out on such divine 'intelligence.' The idea is laughed out of court.

The intelligence is faulty as is everything in the universe; for perfection would mean a stand-still which does not exist. And is a faulty thing divine?

There is no divinity in intelligence, and as intelligence has been shown to be limited to those beings having a cerebral system, *there evidently is no such thing as divinity*, seeing it were a finite entity—limited by that having no cerebral system—and unintelligent.

Force is not divine.

The death-blow to pantheism has been struck.

> "If to conceive how anything can be
> From shape extracted, and locality,
> Is hard: what think you of the Deity?"

asks Jenyns. 'Once upon a time' I imagined or rather had a hallucination of 'deity.' I never conceived it, neither then nor now. Now I cannot even imagine it. *Deity is for me non-existent, it is an impossibility.*

The idea of instinct is a delusion.

That a bee can build its cells, is the result of a combination of heredity and amendment to the environment. That the red ant rears the larva of such insects as *Lomechusa* and *Atemeles* and feeds and brings them up despite the fact that these temporary commensals are such ungrateful guests that when adults, they devour the eggs and young larva of their friendly hosts and are the cause of deformed females and workers (pseudogynes—aphididæ), is the result of an unconscious memory of a pleasant sensation of the ants. The leaf-lice give off a sweet-tasting liquid which oozes out from between the separate rings of the body, and this the larvæ of ants eat. This unconscious memory is set in activity, is stimulated by the taste

or/and smell and perhaps the sight of the insects, and sets in motion the rest of the acts of the ant. Such acts can well be termed *Associative physical functions.* They are actions in which the reason plays no part. The feeling which led to the cohabitation of such incongruous messmates was the palatable or/and otherwise pleasureable sensation or stimulation to the ants accruing from licking these doubtful aquaintances and taking charge of their larvæ.

Our horizon is widening. The mists are rising.

Von Uexküll considers, most probably rightly, that a dog moves its legs when it goes, a sea-urchin is moved by its moving apparatus; but the dog's movement of its legs is not intelligent. The intelligent acts of animals have been defined as such, the interpretation of which admit of their consciousness of a purpose in their actions. But evidently a thing can be done to a purpose without it being intelligently done. Thus the dog has moved its legs to a purpose, but without the exercise of any intelligence in so doing. Moreover, one can intelligently do a thing to a purpose without being conscious of that purpose. *E.g.* to think on any given subject, one often closes the eyes so as to exclude all deterrent extraneous influences; but one is, at the time, not conscious for what purpose the eyes were closed, though the deed was most decidedly intelligent. Paradox as it may sound, there is such a thing as a motive which is not only unconscious but unintelligent, as exemplified in the motified acts of the somnambulist. These motified actions must however be looked upon as reflections of intelligent acts, and bear the same relation to these as the movements of the man in the mirror do to those of the man before the mirror. A very primitive intelligence is clearly that requisite to the cognition and accognition of feeling long before an act takes place. As soon as there are evident signs of feeling, there is intelligence.

Intelligence begins where feeling begins, *i.e.* where there is sense of any kind, for this means the cognition of a stimulation, a variation in the environment, and entails the first experience. That which has a sense of pain or touch or taste or pleasure or smell is intelligent.

An act done to a purpose is one done to enhance or lessen a sensation.

When the sense or feeling of locality is so advanced that the being feeling, accognises that *it* is the place which is feeling, then is there consciousness of feeling. There is no necessity as yet of its thinking 'it is I who feel.' That is simply a higher consciousness,

just as there is a higher and lower intelligence dependent on the development of the cerebral system : and *consciousness is a philogenetic development of intelligence* and goes on developing. (Compare this full definition with the adumbration of p. 22.)

As soon as there is so much sense of locality, that the point of feeling is ascertained, there too is the starting-point for the accognition of a purpose, since after several points on the nervous system having in series been located, there arises a feeling of individuality, and also the feeling that everything is in the direction of the feeling individual. In conjunction herewith, there may probably be the factor of the sense of desideration together with its gratification by the animal or child getting something, which is a pleasurable sensation. Soon arises the idea of 'I,' 'I have it,'—the state of consciousness is there. When the sensory nerves are sufficiently affected, there arises a current in the motor circuit. It is then gradually that the initial reasoning takes the form of the conscious individual acting so as to lessen or enhance a sensation and then feeling that it was this individuality that so lessened or enhanced it : till ultimately, action and reaction being equal and opposite, the individual intelligently and purposely, *i.e.* consciously enhanced or lessened those forces which had caused it to feel.

On this subject various terms are used, but these do not so much express different things or a diversity of conception concerning one thing, as represent a heightened grade of complexity regarding the same, depict an enhanced differentiation. Of course no hard and fast lines of demarcation can be drawn between the stages, any more than it is possible to make a distinction between the vegetable and animal kingdoms; but roughly put: 'intelligence' starts where feeling starts, 'understanding' where the nature of the feeling is accognised, and 'reason' where its purpose is ascertained, whilst 'consciousness' has just been defined. One and all are however but advanced stages of intelligence. An intelligent action, an action undertaken with understanding, and an action carried out under the dictates of reason are severally reactions of the above. When I here speak of feeling as the starting-point, I include all the sensations, for during certain nervous disorders, one or more of the senses can be affected. Were all organs of sense simultaneously to act, there were a perfect loss of intelligence. Among the first senses to develop were probably those of touch (developed into hearing) and light (developed into seeing).

I possess intelligence, understanding, reason, and consciousness,

and by their means form my conception of the universe. At various times various grades of intelligence and at other times simultaneously two or more grades come into play. One and all of these are adjuncts of my cerebral system, of my nerves, brain, and ganglia.

> "The functions of the central nervous system, which were originally taken by the whole skin, became gradually concentrated in a special part of the skin which was step by step removed from the surface, and has finally become in the higher types a well-defined organ imbedded in the subdermal tissues . . . . The embryological evidence shows that the ganglion-cells of the central part of the nervous system are originally derived from the simple undifferentiated epithelial cells of the surface of the body." [1]

Likewise,

> "the brain arises from an unfolded tract of outer skin, which, sinking down beneath the surface, becomes imbedded in other tissues and eventually surrounded by a bony case . . . the human system in common with the nervous systems of the lower animals is thus originated." [2]

The outer layer or epiblast, one of the three original layers of cells which went to form the more composite living organisms, emanated from the primal plasmic cell, this from inorganic matter, and this again from what I have chosen to call the primal force-forms—forms of one eternal infinite force. Thus this intelligently acting, reasoning and conscious force-plexus is part and parcel of the one Universal Force, and, as we could have expected, acted on by all the other parts, and acting and reacting on them. Intelligence (inclusive of its conscious phase) is dependent for its existence on its environment (*vide* pp. 101-102) and it can be annihilated by drug, illness, mechanical destruction of its central organ or parts, and even by climatic influence, as by the intelligence of another either in the waking or in the hypnotic state. Even in the waking state, not only can the intelligence of man be led astray, *i.e.* destroyed; but be employed to kill, to break up the conditions of life in the intelligent individual. *E.g.* it must be some twenty-two years or more since in America an experiment was carried out in one of the Government prisons on a criminal condemned to death, an experiment which has, I believe, in certain circles become classical. With preconcerted ostentation, two doctors brought forth all the implements requisite for undertaking a surgical operation. Then, after binding the victim's limbs, blindfolding his eyes, laying him on

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[1] From Spencer's Essay, "The Factors of Organic Evolution."

[2] *Ibid.*, p. 454.

his back, and making bare one of the legs, the cold metal was placed on the flesh (but without making an incision), then tepid (lukewarm) water allowed to drop from a sponge on to the flesh, whilst the two savants audibly discussed the successive phases which led up to the demise of a person being bled to death. The amount of blood oozing out, the breathing, the pulse and the heart beats, the quivering of the nerves and contraction of the muscles were dilated on at length and in such wise that gradually one after the other the vital organs of the subject of the experiment stopped their functions—the man died, not from an operation, but from a strongly misdirected intelligence.

On the other hand, the intelligence of sucklings either of man or beast is small in degree and increases by degrees. As Spencer very beautifully put it, neither the egg of the chicken nor of the human being have any intelligence, yet, through heat, gradually develop to the sensitively feeling chick and the intelligent child. Firstly there is feeling, then an accognition that the feelings are from forces outside one's self—without that self being drawn into account—next the consciousness that it is one's self that is being acted on, the nature of the effects are consecutively compared, and lastly the facts are accognised that objects other than one's self are being acted on, the nature of such actions, and the reactions immediately succeeding. "*Vere scire est per causâs scire.*" And so strong can our intelligence, the brain functions become when suitably stimulated, that it can exist after all other vital organs of the body are dead, and set that body in motion. The sheriffs and six jurors, as also the Rev. Mr. Meury of New Jersey, U.S., all corroborate the fact, that a minute after a drop from the gallows, a condemned murderer made signals with his hands which were pre-arranged and were therefore no involuntary automatic twitchings.[1]

The causes, the force-forms, are in number infinite. Moreover, though infinite, they are but phases of an entity, of a unit force, the one phase merging ever into the other : whilst our knowledge is from part to part—the parts arbitrarily chosen as dictated by the senses—it is a knowledge of *entia rationis*, which are all too often taken for absolute realities. The force of intelligence—'intellect'—is, like all other forces, a resultant force and like these capable of influencing and being influenced by its environment and of accreting some of this. This force-form 'intellect' is in its action perfectly mechanical and is not in itself intellectual, *i.e.* has no intellectuality, no thinking

[1] *Vide* art. 'Dead Man's Signals,' in the "Daily Mail," 17/8/06.

nor reasoning power within itself any more than its environment whence it came.

There is no intelligent force outside the living animal frame, but it can be transmitted over lifeless space to another animal body of similar intelligence (hypnotism or persuasion), just as the sound of a voice, though not existent in ~~im~~ inter mediate space, yet exists at the transmitter and receiver ends of a telephone line.

Intelligence is, as was on p. 281 hinted, faulty. Our comprehension of the universe can for this reason never be perfect, that there are no such things as homogeneity, absolute balance, or equiponderance. Gravity is never absolutely the same at the two opposite points of a balance. Two things can never at any time be equal in size, weight, or action. As everything is either constantly accreting (gathering in amount) or radiating (losing bulk) in space, any one thing brought into comparison with another, is altering even during the time of such comparison. Within this limitation I can form a judgment or opinion and, says Johnson,

> "A right opinion is that which connects distant truths by the shortest train of intermediate propositions."

But consciousness or the centring or locating of everything in self is not an unalloyed advance in intelligence: for by virtue of this very centring, one has no chance of ever reaching that ideal Bilharzian point of hypomochlion (*vide* p. 84) whence all aspects of force are visible—where is enthroned the absolute truth.

This being no physical treatise, it will here be sufficient to refer the reader who is desirous of studying the exact character and nature of the mental forces, to the principle of tensions in muscle and nerve prisms and rhombi (the muscles having interior, the nerves surface tension), as expressed in the already mentioned electro-magnetic theory of Prof. Dr. I. Rosenthal.[1] This theory seems perfectly feasible, and its development results in the reactive force of comparison. **The immediately preceding collective constellation of force-forms which have comparison for their resultant is 'intelligence.'**[3] It is perfectly mechanical in its action, amenable to the same influences and stimulations as all else in the universe. We do not "think of matter only in terms of mind" nor "of mind only in terms of matter,"[2] but of both in terms of force. *Internal reactions and external stimuli* (*from out the environment*) *therefore*

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[1] "Physiology of Muscles and Nerves."

[2] *Vide* Spencer's "Principles of Psychology," vol. i., § 272, etc.

[3] This comparison may be conscious or unconscious.

compel this constellation of forces—my 'intelligence'—to compare in a given manner and direction and it could therefore, in any given instance under given circumstances and conditions not have compared otherwise than it had compared. We must therefore deduce (*vide* p. 24) *as, taking the nature of each individual's cerebral system into account, the environmental forces compel us to deduce; we form conceptions as we are forced to form conceptions* (*vide* p. 35), *and reason* (*vide* p. 24) *as we are forced to reason.* We compare, deduce, conceive and reason through the medium of the organs of sense,—temperature, food, pressure, light, pain and pleasure, touch, and so on enhancing, decreasing, or annihilating as the case may be. By my memory or storage of impressions—a purely physico-chemical natural attribute of the brain and ganglionic cortices, I gather a certain amount of knowledge (*vide* p. 24), and by virtue of knowledge and conception, both of which as to their characteristics are forced upon me, I conceive the universe as I have described it; but looked at on the other side, it may be different; although from my loophole, through this medium, with myself as observer, under the at present obtaining physical and other conditions, it could not have fallen out otherwise, seeing that I and my environment are in one and unisonant. I accognise the reality though not all the reality (*vide* pp. 86, 266, 267, 287, ¶ 2), the thing though not its absolutely real characteristics. One can only see one's self by reflection as in a mirror. There is here nothing in which for force to reflect itself. 'Intelligence' and its philogenetic 'consciousness' like all else in the universe are born of the polygamic loves of the cosmic forces, and are killed when they separate, offspring having to suffer for the sins of the parents. Intelligence is a reality—an abstract reality (*vide* p. 63)—in each person different, and ceasing with the death of the individual, and under certain nervous conditions (diseases) even before. A perfect idiot [1] cannot compare, *i.e.* has no intelligence; but a madman who compares is intelligent although his intelligence is quite different from ours.

McCabe, who ought to know—seeing that he is the English translator of Haeckel's works—says,[2]

> "Haeckel regards sensation (or unconscious sentience) as an ultimate and irreducible attribute of substance, like matter (or extension) and force (or spirit)."

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[1] In footnote [1] to p. 62, the word 'madman' should be substituted for the word 'idiot.'

[2] *Vide* the art. 'Sir Oliver on Haeckel' in the "Hibbert Journal" for July, 1905, p. 752.

Without finding it here requisite again to go over the grounds which go to show that matter is a disintegratable force-complex, I must make front over against the first statement. Sensation is an intelligent or/and conscious cognition of an irritation. Where there is neither accognition nor cognition, there is no sensation. When a person or animal is asleep in the day-time with open eyes, light is affecting the eye-nerves and otherwise exciting the body, but there is no sensation: whereas when awake, there is a sensation of light even with closed eye-lids. The force of light may however awake the sleeper, *i.e.* be so strong as to bring about a state of consciousness. Where there is no intelligence or/and consciousness, there can be no sensation; there can be no intelligence without a cerebral system; there can be no sensation without a cerebral system; substance, apart from a cerebral system can have no sensation.

Panpsychism is an illusion.

As all in this universe are force-forms, so can only force emanate from force. Bearing in mind that a mental image is a physical act—a physical force—a mental image emanates from a force. Our language being poor, although usually the term is reserved for the true mental image or reflection of an act of force, I am therefore going to employ the expression 'effect' as a designation of the force producing a mental image. In this new sense, an effect is a force emanating in other forces.

An effect has several causes, *i.e.* is the resultant force of two or more component causes, themselves forces.

Let us take an example. When a man marries for money, the act of marriage (in itself a force) is the resultant effect of the simultaneously acting forces, (α) the money itself, (β) the man himself, (γ) the woman herself, (δ) the registrar or other marrying official, (ϵ) the law by which the two become man and wife, (ζ) love or desire of social rank on the woman's part. Without the action of the first of these forces, at all events, the marriage act would not have taken place. It may be urged that money was not one of the causes, but the sole cause of the marriage; but against this I reply, that the presence of the money, or that obtainable for it, could not in itself conclude any marriage between a given couple, although it was the most prominent or greatest acting factor *from the man's point of view;* but *from the woman's standpoint* love or social rank may have been the leading force. *From the government's* ethical and economical *standpoint*, every man wanting the entire fortune of a woman and every woman loving a man must marry each other, the more so as

marriage tends to increase the birth-rate. From the woman's and from the governmental point of view, the woman's money was certainly not the sole cause of the marriage.

An answer to the question as to the priority of the motives or incentives to marriage would in general settle the question as to which motive was the stronger, for the second motive is induced by the possession of the first. Thus, if a man is seeking to make a money match, he either by chance or purposely induces love or holds out enticing prospects and so on. It is of course possible for the man to have two or more motives for such a match, as when the woman possesses not only money but beauty or good qualities. We are prone, by our nature, to first consider a question from the point of view of the strongest force or tendency. In the case before us, the man's motive was first, *i.e.* the stronger as a factor to the marriage act than the woman's. The woman's motive, to express one's self graphically, is a force in another plane. The impelling force is the man's motive, brought about by the presence of money and his sense of desideration. The action is purely mechanical. If the man notices that the woman is getting to love him and makes use of such knowledge to bring about the marriage, the woman's motive to marriage becomes the man's agent. If the woman notices he wants her money but yet loves him, she will use this accognition to bring about the marriage—the man's motive to marriage becomes the woman's agent. *Agent and motive become interchangeable terms according to the aspect from which they are approached.* But in any case, from any aspect, the effect is the sum of the causes, or, agents +means or/and motives.

A thought is a true mental image or the reflection of a certain group of forces in the cerebral system brought about by thinking. Thinking is the general expression for any work done by the filaments or cortices of the cerebral system as generated by exterior stimuli, be it committing to memory, comparing, imagining, deducing, reasoning, following an explanation, and so on. Contracting a muscle, being internal work only, is not thinking. Thinking is the resultant of a complexity of forces in the cerebral system, which has as its agent the living forces of the cerebral system, *i.e.* which maintain the life-condition of the said system and as means the forces of nature generally, including matter generally, inclusive of the special matter of the brain. Thus, if I think of the act of flying, the means are flying matter as seen by me in a butterfly or a bird and so on. Had I never seen a butterfly or a bird or other thing flying, I could not think of

flying. This sight formed an image in my brain, *i.e.* the forces by which the bird, etc., became visible to me were electro-chemically registered, and later on, by some outer influence (an electric mirror—a storage battery) reflected. I could not think of reading, had I never seen or been told of printed words and sentences; I could not think of thinking, had I not observed the results of thought in others. Every thought is the result of something experienced, felt by one or more of the senses, and through these I think. Exterior stimuli act on my senses and produce thought, and were it not for this action, thought were not, *i.e.* thought is dependent on the excitation of the environment.

I cannot think as I will, but as I must.

A young child is influenced by heredity, by climatic influence and geographical position, by education, by what it reads, by its companions, and natural surroundings generally. What one sees can so attract as to compel. One sees the chasm and springs into it. Thus does the boa-constrictor fascinate the poor little squirrel to such an extent that it literally walks into the jaws of death. A young servant girl was so influenced by the sight of cut throats in the room of horrors of a wax-work exhibition, that although she was on the eve of a happy marriage with a young man of her own choice, she writes to her parents on the same paper as that announcing the approaching marriage, that she has cut her throat "as I cannot forget those people lying there with their throats cut."[1]

If to denote the originality of thought in the brain, one make employment of the expression 'rationality,' ***then is rationality an illusion.***

A corollary to this is that **neither man nor brute possesses design nor purpose.** That is to say, they 'plan' things in the way in which they are bound, and their 'purpose' becomes nought but an intense thought forced upon them and about to cause a reaction, and effort of the 'will.'

Just as the action of the muscle can be voluntary or involuntary, so can thought be voluntary[2] or involuntary—one can wish to think, or thought can be forced on one. Voluntary thought is possessed by man alone, it entailing a knowledge of what thought is, an experience not possessed by animals and only "*experientia docet.*" But even in

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[1] *Vide* "Daily Mail" for February 4th, 1905.

[2] This apparent contradiction between the two conceptions of thought being limited by the surroundings on the one hand, and voluntary thought on the other hand, is removed in the next chapter.

man, there are grades of voluntary thought. There is semi-conscious and wholly conscious volition. Thus I can, at will, think to think on a given subject without thinking that I myself am to be the thinker. This is semi-conscious thought. When however voluntarily, I draw a vivid mental picture of my personality as the individual who has to do the thinking, the action is wholly conscious. Involuntary thoughts are those thrust upon me without my cognition that I have to think. Involuntary thoughts can never in man be wholly conscious, as the direct personality is absolutely eliminated. Semi-conscious voluntary thoughts are those taking place wittingly, yet without thinking that one is thinking. Thoughts can however be wholly unconscious. Holmes[1] gives an example:

> "We wish to remember something in the course of conversation. No effort of the will can reach it; but we say, 'Wait a minute, and it will come to me,' and go on talking. Presently, perhaps some minutes later, the idea we are in search of comes all at once into the mind, delivered like a prepaid bundle, laid at the door of consciousness like a foundling in a basket. How it came there we know not. The mind must have been at work groping and feeling for it in the dark: it cannot have come of itself. Yet, all the while, our consciousness, so far as we are conscious of our consciousness, was busy with other thoughts.
>
> "In old persons, there is sometimes a long interval of obscure mental action before the answer to a question is evolved."
>
> "Swift said of Sir Isaac Newton that, if one were to ask him a question, 'he would revolve it in a circle in his brain, round and round and round and round' (the narrator describing a circle on his own forehead), 'before he could produce an answer.'"[2]
>
> "I was told, within a week of a business man in Boston, who, having an important question under consideration, had given it up at the time as too much for him. But he was conscious of an action going on in his brain which was so unusual and painful as to excite his apprehensions that he was threatened with palsy, or something of that sort. After some hours of this uneasiness, his perplexity was all at once cleared up by the natural solution of his doubt coming to him—worked out, as he believed, in that obscure and troubled interval."[3]
>
> "There are thoughts that never emerge into consciousness, which yet make their influence felt among the perceptible mental currents,

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[1] "Mechanism in Thought and Morals," p. 43, by Oliver Wendell Holmes; pub. Sampson Low, Son & Marston, London, 1871.

[2] "Mechanism in Thought and Morals," pp. 45-46, taken from a note to 'A Voyage to Laputa.'

[3] *Ibid.*, pp. 46-47.

just as the unseen planets sway the movements of those that are watched and mapped by the astonomer."[1]

There is, I firmly believe, hereditary memory, *i.e.* what our ancestors had for years incessantly or supremely thought or felt may if sufficiently impressed or registered on the cerebral cortices, be so indelibly interwoven with the bodily structure that an idea or train of thought suddenly lets these trains of thought free, and these two thinking systems interlacing, one receives not the normal coherency of thought, but fancy, imagery, may be even lunacy. That this latter is often hereditary we know. Our thoughts then, are not only affected by that experienced by us personally, but by the lives of our forefathers. "What happens," asks Holmes, "when one idea brings up another?

> Some internal movement, of which we are wholly unconscious, and which we only know by its effect. What is this action, which in Dame Quickly agglutinates contiguous circumstances by their surfaces; in men of wit and fancy, connects remote ideas by partial resemblances; in men of imagination, by the vital identity which underlies phenomenal diversity; in the man of science, groups the object of thought in sequence of maximum resemblance! Not one of them can answer. There is a Delphi and a Pythoness in every human breast.
>
> The poet sits down to his task with an odd conceit in his brain and presently his eyes fill with tears, his thought slides into the minor key, and his heart is full of sad and plaintive melodies. Or he goes to his work, saying, 'To-night I would have tears,' and before he rises from his table, he has written a burlesque, such as he might think fit to send to one of the comic papers, if these were not so commonly cemeteries of hilarity interspersed with cenotaphs of wit and humour. These strange hysterics of the intelligence, which make us pass from weeping to laughter and from laughter back again to weeping, must be familiar to every impressible nature; and all is as automatic, involuntary, as entirely self-evolved by a hidden organic process, as are the changing moods of the laughing and crying woman. The poet always recognises a dictation *ab extra;* and we hardly think it a figure of speech when we talk of his inspiration."[2]
>
> "It is not strange that remembered ideas should often take advantage of the crowd of thoughts, and smuggle themselves in as original. Honest thinkers are always stealing unthinkingly from each other. Our minds are full of waifs and estrays which we think are our own. Innocent plagiarism turns up everywhere."[3]

This has a most important bearing on the question of instinct,

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[1] "Mechanism in Thought and Morals," p. 51.

[2] *Ibid.*, pp. 59-61.

[3] *Ibid.*, pp. 62-63.

those acts which appear instinctive being more often than not, shafts of thought let loose from the experience of the past, as when a child is afraid of big animals. It requires usage to get accustomed to these. Just so is it with dark rooms. We can trace this back to the earliest times, when our anthropoid ancestors, human beings undeveloped only because of the premature ossification of their brain cases, shuddered as they fearfully scuttled past the dark caves wherein lurked their dangerous more brutish enemies. C. Marsh Beadnell, according to "Science Siftings,"[1] believes, very probably correctly, that

> "Our remote ancestors, in order to avoid their nocturnal foes, slept, like the existing apes, cradled in the tree-tops. To fall from their perches during heavy sleep or boisterous weather could have been a by no means uncommon event, though it is highly probable that they did not fall the whole way to the ground but succeeded in saving themselves in their headlong flight through the darkness by clutching the branches."

Nocturnally climbing reptiles too, of vast dimensions, may have scared our dear forefathers from their arboreal slumbering quarters.

> "It is significant that the motions of 'frantic clutching' may be witnessed in the human being. This is the normal state of affairs in the child."[2]

It is the first movement of the drowning man that cannot swim, who strikes out as if he were climbing trees, and thus lessens the chance of saving himself, just as the dog that cannot swim tries to rescue itself by going through the movements adopted by it in running. These prehistoric experiences would account for the persistency and universality of the horrible nightmare of falling over a precipice and tumbling down, down, through the air—but before striking the ground always again waking up.

> "Why should this 'falling through space' dream recur so persistently in the human race? Because the vivid sensations consequent upon the 'fall,' to which our arboreal ancestors were so liable, produced in their cerebral cells definite molecular readjustments, which, in time became transmitted to descendants. Those of our ancestors who fell to the very bottom of the tree were either killed outright or so injured that death from secondary causes prevented them from reproducing their kind; therefore, molecular changes in the cerebral cells due to the shock of 'stopping' would

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[1] "Science Siftings" for April 21st, 1906; pub. "Science Siftings" offices, Fleet Street, London.

[2] *Ibid.*

not be transmitted. This explains why, just before reaching the bottom of the dream-precipice we awake.

"Another unpleasant and not uncommon dream is of being chased by ferocious animals. A characteristic of this nightmare is the complete inability of the victim to flee from the terrible monster which he imagines to be chasing him. Shrieking with terror, his legs like lumps of lead, he is in much the same plight as a small bird, who, hypnotised by the cold stare of the serpent, is unable to escape. Fortunately, in such dreams also, we awake just before the dream-monster actually pounces upon us. In prehistoric epochs our wild or other progenitors lived surrounded by formidable leviathans, flying dragons or pterodactyls, atlanto-saurians with thigh-bones six feet long, and hosts of other awe-inspiring and colossal mammoths. In such perilous times they must have been frequently chased by these huge beasts; those lucky enough to escape would transmit to their descendants the cerebral molecular changes resulting from the exciting 'run for life.'"[1]

Whoever has seen the gibbon—one of the four most man-like apes now extant—running along at breakneck speed, its widely distended cavernous mouth sending forth its ear-rending trill, its long spidery arms held high above the head, can perhaps form some remote mental picture of these flights of our patres from nigh sudden death.

This question of dreams brings us up to that of double-consciousness, to which the Parisian Dr. Anam has given the name of 'amnesis,' for there is little doubt that when one imagines to have done something or seen something once before, which one actually sees or does for the first time, that very often it is that done or seen in dreams which is at the moment believed to be a prior occurrence or event of the waking state. In like manner, the imagination can be so vividly impressed by descriptions read, of scenes or events, of places and of things, that long after that perused has been forgotten, similar surroundings to that described give one the idea of having once before seen that which one views for the first time. Differences of course there are between the mental images of the dream and the fully conscious state, but discrepancies are lost sight of, the mind in this condition being prone to remember the similarities, not the divergencies and the similarities appear first. There is no need for the far-fetched explanations often proffered either that the two optic nerves fail in their absolutely synchronous action, due to an unequal or abnormal blood circulation, comparable to epileptically or alcoholically occasioned double-vision; nor that the mind quits its

[1] "Science Siftings" for April 21st, 1906.

earthly integument during sleep, to recede within its tenement with newly acquired experience (the idea alike of primitive races and of spiritualists); nor the yet more preposterous notion that whilst in the embryological condition, a child visualises the entire of its future existence and, after birth, passes rapidly in review some few phases of this once complete image.

The belief in prophecy is founded in much the same manner as the idea of having seen things once before. One remembers the things which have come true, neglecting and eliminating all that never came to pass. Prof. Vignoli very suitably calls this mental condition 'paramnesis' or memory forgery.

Error, giving rise to a notion of double consciousness, can also very easily accrue from a false association of thoughts and feelings, or from the association of suddenly made conscious, at first unconscious thought, with thought which all the while was conscious. Two quite distinct actions may produce a similar feeling or impression.

We shall have to discriminate between this idea of a double consciousness proper, and the actual capability immediately to recognise places and things from a once read, accurately and impressively written delineation of them.

The appearance of a dying person to one in a dream, may be miles away, or what is known as a 'death-bed apparition' appears to be a well authenticated fact, but there is no reason for explaining this by presupposing a preternatural 'second self' turning up at a distance from the dying body, for there is no ground for disbelieving the likewise well authenticated evidences of telepathy in which intense thought is transmitted over vast distances, and can be interpreted by this. I have on page 98 drawn attention to Rudyard Kipling's dream of his dog's death. Reversely, the ancient Gaels believed that dogs were sensible of their master's death, however wide apart they might be from each other.

> "The mother of Culmin remains in the hall . . . . his dogs are howling in their place . . . . 'Art thou fallen, my fair-haired son, in Erin's dismal war.'"[1]

On a par with suggestion carried on after hypnotising, telepathy does not presume that the medium of transmission—air or earth—be itself a thinking medium. Thought can be transmitted as a marconigram, or a telephone message, or as a Tesla wireless force transmission. In the first, no letters or written words float through

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[1] Ossian, "Temora" V.

the air; in the second no sound is heard within the transmitting wires; and in the third no force is felt in the space through which the thousands of horse-power are wondrously urged. Thus with thought.

Says Holmes:[1]

> "We all have a double, who is wiser and better than we are, and who puts thoughts into our head, and words into our mouths. Do we not all commune with our own hearts upon our beds? Do we not all divide ourselves, and go to buffets on questions of right and wrong, of wisdom or folly? Who or what is it that resolves the stately parliament for the day, with all its forms and conventionalities and pretences, the great Me presiding, into the committee of the whole with Conscience in the chair, that holds its solemn session through the silent watches of the night?"

What is it, but a comparison of feelings, of experienced pleasures and pains. Ah, but pleasure and pain—what are they?

All feelings are pleasurable that accrue from the stimulations of forces acting in unison with the general environment, whilst painful are those acting against it.

This idea of unisonance varies with the point of view and mental and physical condition of the person or animal feeling. As we have seen, those suffering from nyctalopy or who by nature are nyctalopes see light where we have darkness and their darkness is our light. So also there are those who receive quite different impressions from colour to the normally constituted mortals. Thus there are persons who get excited by that colour which in most people produces a quieting effect. Landor found among the Ainu or hairy ones,[2] a man excited by blue, a colour which we have seen (*vide* p. 40, footnote) acts on the majority as an anæsthetic. In his own words:

> "A man in the crowd would get excited, and opened his eyes wide and showed his teeth every time I happened to touch with my brush the cobalt blue on my palette. *Other colours had not the same effect on him.* His eyes were continually fixed on the blue, anxiously waiting for the brush to dip in it, and this would then send him into fits of merriment."[3]

A lion's whelps do not feel the pain of their mother's licks as does a

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[1] "Mechanism in Thought and Morals," pp. 66-67.

[2] A hairy race of about 15-17,000 head, living on the island of Yezo belonging, with the Kurile group to the Hokkaido (41°-51° N. lat., and 139°-157° E. long.) and of which now only 8,000 are thoroughbred, the remainder having commingled with the Japanese and become half-castes.

[3] "Alone with the Hairy Ainu," p. 7, by A. H. Savage Landor; pub. John Murray, London, 1893.

human being. A madman has other conceptions than ours, and may be

> "There is a pleasure in being mad
> Which none but madmen know.[1]

> "A happiness that often madness hits on,
> Which sanity and reason could not be
> So prosp'rously deliver'd of."[2]

Much mirth makes melancholy, much melancholy makes madness, and madness makes mirth—the circle is closed. The heathen woman who, 'according to her lights,' offered her newly born offspring on the fiery altar of Moloch 'went with her times' and was just as good and just as happy, just as proud of having done her duty and went with just as buoyant a stride and head as raised as the Christian woman of to-day who makes no sacrifice whatever to her belief, but who condemns the sacrifice of a babe, for whatever reasons, as infanticide. The heathen woman would have been reproved for pretermission of the sacrifice, she had done wrong, she would feel unhappy, ashamed; the child murderess of to-day if not hung, would be impaled for years if not for life, and her cup of bitterness were full to overflowing. The Catholic who zealously essays to rigidly follow the to me shameless and outrageous codex of St. Alfonso Maria de Liguori may be, accredits himself with as high a standard of morality as any Puritan, most probably he deems himself better than the more faithful Protestant follower of Jesus or the believer in Buddha who strenuously tries to lead the life of which two of the best men who ever lived or of which at least we have any record, have given us such admirable examples.

When the sense of desideration, *i.e.* the tendency to have something, is satisfied, there is pleasure, and thwarting it brings pain. Some people find a joy in teasing, bullying, beating others. This, little by little leads up to sexual emission. Such are sadists, who are happy at the pain they inflict on others and these others allow—see no wrong—in such action, for they understand it. They can even like being hurt, as one sees in the boy or girl at school who likes being kicked and who grows up respectively to be the hen-pecked husband, or the woman who lets herself be tied or bound and whimperingly suffers the knaggy birch to lacerate the tender flesh till she swoons away—the massochist. Such instances are in civilised countries rare, but they are also found

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[1] Dryden: "Spanish Friar," Act II., Sc. 1.

[2] Shakespeare.

as a normal condition of life. Thus, the tribe of Cah-brogal (named from the worm cah-bro which its members eat) living on the banks of the Hawksbury River, New Holland, seem to be natural sadists and massochists. Malthus[1] gives the following extract from Collin's "Account of New South Wales" (Appendix, p. 559):—

> "The prelude to love in this country is violence, and of the most brutal nature. The savage selects his intended wife from the women of a different tribe, generally one at enmity with his own. He steals upon her in the absence of her protectors, and having first stupefied her with blows of a club, or wooden sword, on the head, back, and shoulders, every one of which is followed by a stream of blood, he drags her through the woods by one arm, regardless of the stones and broken pieces of trees that may lie in his route, and anxious only to convey his prize in safety to his own party. The woman thus treated becomes his wife, is incorporated into the tribe to which he belongs, and but seldom quits him for another."

That the above acts, savage though they may appear, are not wanton acts of cruelty, seems certain when we are informed that the wife is

> "treated the same after marriage."

There are many of those about us who find delight in making martyrs of themselves and are never so glad as when they are making themselves miserable.

Thus sings Nietsche:

"Mitternacht ist auch Mittag.	"Midnight is also midday.
— — — — — — — — —	— — — — — — — —
Schmerz ist auch eine Lust,	Pain is also pleasure,
Fluch ist auch ein Segen,	Curse is also blessing,
Nacht ist auch eine Sonne.	Night is also sun.
— — — — — — — —	— — — — —
Alle Lust will aller Dinge Ewigkeit,	All pleasure will have ev'ry eternal thing,
Will Honig, will Hefe, will trunkene Mitternacht,	Will have honey, will have yeast, will have drunken midnight,
Will Gräber, will Gräber-Tränen-Trost,	It will have graves, and grave-tear-consolation,
Will vergüldetes Abendrot."	Will have a gilded ev'ning glow.[2]

Pain and pleasure are but interchangeable terms (*vide* also p. 18).

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[1] "Essay on the Principle of Population," p. 17.

[2] From Nietsche's song, "Noch ein Mal." *Vide* his "Also sprach Zarathustra."

That which gives pleasure is right, that which gives pain is wrong. That is wrong which gives to a person pain, but the same thing is right to another to whom it gives pleasure. An action done for a purpose appears good to the doer, for it satisfies him, even though it be done to hurt, *i.e.* to harm another. He justifies his act in his own eyes. He may however know that others may think his act evil, he may even fear the censure of those others, feel shame. An act is good or bad according to the motive with which it is done. If it be done to do good (according to the ethics and the moral trend of the times and the place of its occurrence) it is, for the time and place in which it occurred, good; and if it be done to do wrong, it is for the time and place in which it occurred, wrong.

There are several ways of being against the tendency of the environment. For instance, when a flow of water is let over or against a water-wheel or turbine, certain directly calculable eddies occur. So do all other forces lose a part of their power in eddies caused by the position and resistance of the surrounding forces, and that within the eddy-action against the prevalent general tendency of thought and action, means wrong and pain. Some of the water flowing on the wheel passes out at its side and is absolutely lost. A loss is a break in the tendency: there is pain. When I interrupt a constant current with which I am in electrical contact, *i.e.* when there is a sudden loss, I at once feel pain. When a current is first sent through a wire, the wire offers a certain initial resistance to it, and only when the current is kept up, will it pass right down the wire. When one starts an innovation, it is offered resistance, it is wrong till one gets used to it—till the act becomes usage.

The general tendency, the moral standard of an age, is right in that age, but most probably for that age only. It is difficult to find a criterion as to what is and what is not in accordance with the obtaining tendency and what one may deem progression another deems retrogression. For me, that which tends to perpetuate the existence of the universal force is the right, is the universal tendency, of which each individual sees but one part (*vide* Fig. 11*a*, p. 256). But even this wider conception is not held by all, as in the case of believers of a possibly obtainable state of Nirvana, or of the suicide of a Schopenhauerian who imagines that as only will exists, with the cessation of his being, all existence will have ceased. Perhaps this holds good with a follower of Boscovitch (*vide* p. 74).

Everything has according to the position it takes up in the

universe, its own specific characteristics or nature—so also every person. As a person's nature, so differs one's conception of the prevailing tendency and one acts accordingly, doing that which would appear wrong to another. My own personal view is that there is in human and in some animal natures a principle of ethical increase, in accordance with the ideas of ethics as evinced in the ethical movement of the ethical societies of England and Germany at the end of the 19th century. True it is that in the history of the world, there have not only been times of betterment but also times of dire evil-doing; but I am under the impression that each reformatory wave has been of a higher standard than the one preceding it, and that graphically the ethical tendency might have been best represented by such a diagram as Fig. 11*b* (*vide* p. 256). At the present time, there is no recreant so vile who does not in some way or other seek to justify or put a correct aspect on his criminal deeds. This does not however point to the existence of a fixed standard of justice, for the idea of justice is, like all things else, mutable. Although the standard of justice is not alike high in successive periods, the general tendency of all the ages in which man has existed has been that of a continually increasing standard of justice and of morality generally in our sense of the term. The height is nearly if not quite attained, and with a decrease of the vital tendency as by me prophesied, there will be a proportionate diminution in the ethical standards.

A certain class of actions (hinted at on p. 17) remains to be explained, those mimicked or copied from others.

In this work, the fact has been considerably dilated on, that mental impressions received and stored, repeated, and again stored, at length so prey upon the mind that one begins to think of nought else, this impression becoming paramount to all others. In a somewhat similar way, anything making a great impression can to such a degree operate on the cerebral system as to completely or nearly exclude all other influences and even in some cases to obliterate the older ones. Together with this, must be taken into account, that each and every mind is differently constituted; and what might make a great impression on the one, may make next to none on the other. Grouping these items, it may be possible to come to some sort of a conclusion as to the nature of mimicry. A deep mental impression in some one or other form appears to be the prime cause. I must say, as not included is the mimicry so-called but wrongly, which is purely a physico-chemical process, partly assumed, partly inherited,

which is to be found in those instances in which animal, bird, or insect take on the colour or/and structure either of a part of their environment, or of some other animal, bird, or insect. One sees such an assumptive mimicry, when certain fishes change colour according to the ground over which they are passing; and such inherited mimicry in the instance of the white fur of the polar bear, although the white was in the first place gradually assumed.

There are certain sensations, which in general produce so keen and lasting an impression, that their image is easily obtainable. Under this heading are gaping and coughing and so on, as also the making of grimaces at seeing some one doing the same on eating a sour lemon or taking nasty medicine. Laughter evokes laughter; seeing anybody vomiting will often provoke vomiting; and a good example give rise to good deeds. In this class must also be included the speaking of a parrot, the singing of a canary.[1] This primary mimicry is therefore the outcome of an adaptation to surroundings and finally a philogenetic derivative there of the tendency to become similar to the environing medium. When one sees some one else gape, it so reminds one of the sleeping hour and one's own gaping, that the cortex, nerves and muscles are set in action and bring about the action of gaping. Coughing occasions a poignantly irritating feeling, and hearing another person cough at once induces the hearer to cough, in order in such wise to rid him or herself of the disagreeable scratching imagined to be felt in the throat. This mimicry is perfectly involuntary, as there is no intention of copying the gaping, the coughing, the making of grimaces, and the like. To speak of the contagion of laughter is nearly correct, for it is the laughter of one which induces laughter in the other—the exuberance of one imparts a like temperament to the other. In like wise, one just as often cries during a theatrical tragedy at seeing others cry as at the piece itself.

In a second category must be grouped such phenomena as the singing (lollards) and dancing mania, tarantism, the acts of the convulsionaries, religious revivals, and the like: one and all stimulated,

[1] That the singing of a canary is not speech, is best demonstrated by the fact that many a breeder of canaries teaches his fledglings to warble their loveliest notes by causing them to hear and then imitate the mechanical trills of an automatic singing apparatus. Against this, may be urged, that the automatic trilling adjustment but reproduces the language of canaries and that our yellow friends but reply to the speech of the machine. This latter is improbable, as the language of birds not having been sufficiently studied as to construct an instrument capable of ornithically logic utterance, the tones produced are not exactly those of canaries and would not be understood by them. Not only is there a lack of sense, there is a want of intonation as an expression of the emotions; for duration, pitch, and timbre are exact imitations of the automaton.

may be, by imposture and indecent motives. Here, not only does the sight of dancing, the sounds of singing, the fervidness of prayer so acutely impress one as to arouse similar perfectly involuntary sensations which set free the levers of action, but there is at first, likewise a desire to feel and to do as per example set. This however but enhances the effect, and in the end, so penetrates and imbues the cerebral system to the exclusion of all else, that insanity takes the place of intelligence. Religious fervour especially is mentally dangerous and easily leads to mania. It is mentally weakening, and as, as a rule, only the mentally strong are morally strong, it follows that ultra-religious fervour is conducive of moral weakness. The deeply religious man is so engrossed in his religion that he has little or no initial mental energy left to analyse that which goes on around him, and is, in all except his religion, easily wafted from one extreme to the other.

We are digressing: let us return.

A third category of mimicry includes the playing of an actor, the masked behaviour of men and women seeking in cunning wise to influence their brethren by sporting a style and character they do not normally possess, the affectations small and great of society generally. These actions are completely voluntary.

The mind of an actor is strangely influenced by all he sees and hears; it is one quick of comparison between movements, gestures, general carriage, and voice intonation, and takes note of every little variation which would have been overlooked by another. So impressed is he by what he sees and hears that he at once copies it. As instances of this kind may be quoted together the mimicry of a monkey, and the acting of a Toole and of an Irving, only that the degree of intelligence is greater in the latter. In the monkey, there is the voluntary desire to do as he sees done. In the case of the Italian organ-grinder's monkey, there is also the idea of eluding the pain of a beating for non-compliance or that of gaining the pleasure of something nice to eat for fulfilment of an act of mimicry—there is a purpose in the act. In the acting of the stager, there are the complimentary purposes of portraying with the desire of holding up to blame or praise and that of desiring to earn a living—a full consciousness that his natural mental idiosyncrasies can be adapted to purposes of self-preservation. When, to gain his own ends, which are dishonourable, a man affects the acts of an honourable man, he is evidently so impressed with the actions of the honourable man and the resulting esteem in which such man is generally held,

that he feels he can only succeed in his nefarious practices, by copying these traits and actions. The little man is so impressed with the success met with by the general deportment of the great man, that to have the same social good fortune with his fellow-men, he 'apes' the behaviour of the great man to his own delectation and the latter's derision.

Just as primary involuntary or unconscious mimicry is a sequence of an adaptation to the environment, so also is the voluntary or conscious mimicry, for it is an adopting of that, felt to give pleasant impressions or/and results.

What position, in regard to intelligence, do we take up over against the animal kingdom?

Intelligence is a function, probably electro-magnetic (*vide* p. 288) of the cerebral system which has evolved of an animal organism having no such system. But is this function only to be found in the human cerebral system; or are there other cerebral systems (animal) with a like function?

It is, in the first place, difficult to see why it should be absent. If I put one Léclanché cell on the table and another in the cupboard and connect each separately to bells, I see no reason for assuming that the one can ring a bell whilst the other can not. As long as the connections are similar, the place *per se* makes little difference. The system can be influenced by several causes. The wires in the two systems may vary in length or kind of metal. The carbon and zinc may not be pure. The electrolyte may vary in specific gravity. Next to this, the conditions of work may vary. Thus, one bell may be heavier to work than another. Then again, that battery will the longest maintain its specific gravity which stands in the moistest place and under the greatest barometric pressure, evaporation then taking place the most slowly. Lastly, to ring a bell electrically, a Léclanché cell is no absolute *sine quâ non.* One can also employ a Daniel, a Bunsen, a bi-chromate, or a Smee cell or even a storage battery, although the duration and degree of the action will hereby be affected. Thus with the cerebral system. It depends under what conditions it is working. It depends on nourishment, temperature, pressure, size of the animal (length of the nervous conduits), structure of the tissue and the nature of the protoplasmic matter, and the capacity, the efficiency of the system generally (inherited and gained) for the work it is set.

As with all else with which we have had to do, it is very difficult to fix on any one fact as marking a transition stage from one state to

another. Thus, although the evolution of nerves and of a cerebral system generally can be traced, it is nearly impossible to say in what living being the circuits of the cerebral system were first closed. Most likely they were closed after birth[1]; and also that the motor was completed before the sensory circuit.

Not awaiting so rich a harvest, the earlier formations have in this respect received, except with a few exceptions in latter years, but the scantiest attention at the hands of the leading authorities of this branch of science, who have preferred to give their best efforts to more advanced stages of life. It must be borne in mind that the cortices of some of the most primitive ganglia or of portions of ganglionic matter must be of so fine a nature, that their very finding is a matter of difficulty, whilst their study requires far more than the usual care and takes up much more relatively valuable time, the results of such investigations having a greater scientific than a practical value. Another fact, that must not be overlooked, is that not only do animals differ from human beings in the capacity of their various sense organs, to which several savants have already directed our notice, such as some seeing more, some seeing less [compare the eagle and the mole, or the ants, bees and wasps, which having ultra-violet in the white of their optic organs, see everything in another hue (the ants avoiding ultra-violet) and may be see that which is to us an impossibility and having organs for the reception of vibrations imperceptible to us, hear differently], but as one great man especially has shown us—I refer to John Lubbock—there are sense organs which we do not understand, so that in some animals intelligence may exist of which we can have not the slightest accognition. Their movements may therefore in part or wholly be such as to be by us completely unintelligent. Thus mention is made[2] of the jelly-fish (Trachynemadæ) having a group of long hairs arranged in pairs at the base of the tentacles, the use of which is quite problematical. So also have sea-anemones (Actinea) a not understood circle of blue bladders, within which are the cylindrical organs containing a fine thread and terminating in a 'cnidocil' and fibres like nerve-threads, swelling from time to time with ganglionic expansions and also ending in a cnidocil; fishes, muciferous canals containing luminous eye-like bodies; Pleuromma, a set of pyriform

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[1] Here used in the broader sense of gaining their individuality.

[2] "On the Senses, Instincts, and Intelligence of Animals," pp. 182-190, by the Right Hon. Sir John Lubbock, Bart.; pub. Kegan Paul, Trench, Trübner & Co., London, 1891.

organs and a pleural eye (?); Sarolis, appendages on the second thoracic leg; Eurycopa, on their maxillipeds; spiders, on their metatarsus; and Polydesmus, a finger-shaped organ on their antennæ, etc.

We have had occasion to notice the phototropism of the hydra, and Lubbock shows that earthworms and newts are similarly affected *viâ* their skin, for light influenced their movements after (α) separating the cephalic ganglia, (β) after covering the eyes. Experiment likewise showed that blind woodlice were possessed of a similar tropism.

A last point to be considered as regards intelligence, is that until a year ago, too great a capacity had been expected of the cerebral system. The researches of Prof. Starling[1] and others have shown that the organs excrete each their specific chemical substances or Hormones which stimulate *seriatim* the organs. In many cases these have been collected from their respective sources, whilst one of them (adrenalin) has already been synthetically set up in the laboratory. No longer therefore is it necessary to assume that in each instance the cerebral system was at work, much being done indirectly *viâ* the medium of these organic compounds.

> "Without the appropriate hormone the link in the chain of events is snapped and the whole machinery is thrown out of gear. From this it can be seen how a disease affecting one isolated part of the body causes a general feeling of illness and incapacity.
>
> For instance, without their proper hormone not only do the whole of the *sympathetic nerves refuse to act naturally, but they cannot even be galvanised into activity by an electric current.*"[2]

It is even to me conceivable that hormonic discharges may therefore occur, with which the cerebral system, as such, had even primarily nought whatsoever to do, and thus bring about actions and movements upon which, one way or another, a quite wrong construction might be placed.

Yet with all the above difficulties with which to contend, one can, I believe nevertheless, come to some definite conclusion.

In fish, the sensitive nerves of which only go to their primary roots (they have no secondary) and in which there are more ganglia and more developed ones than in mammals, I have undoubtedly seen signs of intelligence (*vide* p. 271). Through something in the

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[1] *Vide* the Croonian lecture of Prof. Starling delivered at the College of Physicians on June 22nd, 1905.

[2] *Vide* "Daily Mail," June 23rd, 1905.

nature of the fish (I experimented with gold fish), they scudded away at the first sounds of my whistling. I put in food at that side of the containing vessel whence the whistling proceeded. They appeared afraid to touch the food. After a few days, the sound of whistling no longer disturbed them, and they quietly ate at their *al fresco* concert. After about a month, they would come when I whistled although there was no food, and wait until I put the food in. Whether they heard or felt the whistling, I cannot say, though probably the former; but certainly that which had originally been avoided was now an attraction, and a feeling of pleasure—of food to come—had arisen at the instance of that which gave the pleasure (sound), *i.e.* there was even a remembrance of pleasure imparted by the sound. Such a power of memory must therefore lie in certain ganglionic cortices. Edinger tells us that carp like the sound of a bell and approach the neighbourhood the sound comes from. Kreidel also tried ringing, but found that the fish only came when there was food. It is therefore probable that from a feeling of pleasure, little fish sport in the sun, although the larvæ of lower marine animals do so because of their phototropistic character. How difficult it is to decide such questions, may be gathered from the fact that although Schaper destroyed the entire nervous system of early frog larvæ, they grew up and swam about despite the absence of such nervous system. On the other hand, with man, the power to walk is getting lost, and we have in many instances to be taught it. Fish either hear or feel the clapping of hands and the shooting of a revolver, and this even when the labyrinth has been removed; but as they do not, without a labyrinth hear or feel whistling, it must be taken for granted, either that these latter sounds are so mighty that the fish are overcome—as tears come to the eyes at suddenly seeing something more vastly stupendous than aught before beheld, as when for instance I came for the first time in sight of the new Forth Bridge—or that feeling was *viâ* the skin generally, or that the sight of the fish was sufficient for it to see the comparatively large ripples,—which is not at all probable, the visual organs being relatively poorly developed, although fish flee from before sudden shadows,—or lastly and most probably, that the lateral nerve (from head to tail) is receptive to a small and the labyrinth to a great number of waves of sound per second in water, the former especially being capable (according to Bonnier) of accognising the direction whence the fluctuations in the water movement proceeded. Fish can be made shy or tame. Gold fish, trout, perch, carp, tench, minnow and weft-pirn recognise and

follow their feeders. V. Mushage in Sablon-Montigny informs us that a copius fossilis is so used to being taken out of the water when the aquarium is cleaned, that it now of its own accord goes on to his hand and there rolls itself together. There are similar accounts from Walther and H. Wallen (Germany) and from Flower (Siam). All the above tends to show that fishes have senses, and that which has sense is intelligent (*vide* p. 284), *i.e.* some fishes are intelligent. Besides the cases of coming to be fed, we must notice that places which are often fished and nearly emptied of fish are avoided by fish; that pike which have come into connection with the sling, avoid it. It is related, that a large pike that was not disturbed by passers-by or even when touched, at once disappeared at the sight of a harpoon with which it had once been pierced. From these facts, can be deduced that fish can act intelligently. Their acts are not on a par with those of the Sundew which gains its kinesia from some æsthesiogenic property of the insect, over which it closes and assimilates its juices or

> "when the pistil of a flower which has received pollen from another plant closes tightly upon it."[1]

A horse has times out of number proved itself remarkably sagacious, but it suffices here to draw attention to the fact that it can be frightened, remember the place where it got a fright, and (*purposely*) seek to avoid such place.

> "A founder'd horse will oft debate
> Before he tries a five-barr'd gate."[2]

It is, it is true, unconscious of a motive, but the motive exists, as does all other thinking of the horse go on unconsciously. It compares places which it felt were unpleasant with others which had not been tried, choosing the latter. The horse remembered, felt, compared, made choice and acted with a motive. The elephant remembers an insult, harbours revenge for years, and then with malice aforethought, attacks the unwitting wight who had dared to ruffle the equanimity of his pachydermatous majesty. Even birds, which are not as a rule very intelligent (except a few trainable species) are not always devoid of all reasoning capacity. Thus most sea-fowl

> "readily distinguish between the Sea-Eagle and the falcon when on the wing and vary their tactics, and escape capture *accordingly*. Thus

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[1] *Vide* the art. 'Automatic Animals' by E. Kay Robinson, in the "Daily Mail" of Nov. 3rd, 1905. The ideas expressed in this article appear to me to be utterly at variance with some of those found in "The Religion of Nature"—a work by the same author.

[2] Swift.

> when pursued by the falcon they dive, but in fleeing from the eagle they depend on their ability to turn rapidly on the wing, which the eagle is unable to do."[1]

Let us now pass on to the dog, the friend of man—my friend whom I love, because he has done me personally much good and never done me any harm. With perfect impartiality it can here be stated, that certain acts, such as stroking or playing with it, make a dog wag its tail. For the sake of argument only, we will assume that we have no idea why it wags its tail—if, as an expression of pleasure or of pain or directly as the result of an excitation. If now, one does as if one is going to stroke or play with our canine pet, the same performance of tail-wagging is gone through, there is an expectation of pleasure or pain to come—there was imagination, the action of wagging was not simply the result of stimulation—and to put all doubt aside as to whether the expected (remembered) sensation is pleasurable or painful, doggie does not bite, but puffs out its laughing hay! hey! hay! loosens the previously set teeth and relaxes the muscles of its mouth. It does not smile purposely to smile, is not conscious of smiling, nor for that matter is man except in some rare cases when he is purposely acting a part to deceive others, where he has accognised that relaxed muscles of the mouth are concomitant with friendly sentiment. Beware of the man or woman who consciously smiles. E. Kay Robinson, paraphrasing Herbert Spencer, declares that a dog's devotion to man has its origin in gregariousness, in it originally following the leader of the pack. Spencer's own words are:

> "Sympathy may be proved, both inductively and deductively to be the concomitant of gregariousness."[2]

Where is the sympathy which a wild dog feels for its dead fellow? Where is the sympathy which a pack of wolves (also gregarious) feel for their wounded or dying mate which they devour? Such intelligence have dogs, that they can even be shown how to control certain muscles, which normally are involuntarily contracted. In September, 1904, the dog Billy, a pure white full-blooded setter belonging to Mdlle. Chester, was exhibited at the London Hippodrome, and which had been taught, during a set of 'living pictures' in which it took part, to control its muscles in not moving under very trying situations and positions, and especially whilst posing

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[1] *Vide* "Knowledge" for July, 1905, being an abstract from the "Field" for June 17th, 1905.

[2] *Vide* Spencer's Essay, "Morals and Moral Sentiment."

with distended tail in 'pointing,'—a feat which showed up the dog's awakening consciousness in a vivid light, for it had to do something with his own person.

This power of controlling special muscles, man possesses in common with the dog Billy. A few persons have still the power of moving their ears and the scalp of their heads by bringing muscles into play, long in disuse. I have myself cultivated the movement of a set of muscles which have up till now, I believe, been deemed beyond the power of voluntary excitation. When, owing to a nervous condition of mind and body, the stomach nerves become in such wise affected that constipation sets in, I have, after long practice, succeeded in setting the sluggishly working peristaltic motion of the intestinal canal in quick action, thus facilitating the passing of the fæces without any of the usual undue and injurious exertion and force. The movement takes place from right to left, by concentrating all my thought to the attainment of this end. It remains to be seen if diarrhœa can be alleviated by a voluntary antiperistalsis.

My little dog—a sweet Yorkshire terrier—had, when a puppy, been playfully introduced to bits of wood which were thrown for it to run after. By degrees he was taught to fetch and carry. When going shopping, he saw me carrying small parcels which he wanted the pleasure of carrying, and would jump and spring about and bark (his ways of demonstrating expected pleasure and of asking) till it was given him, whereupon he exhibited his feeling of pride at being entrusted with the package by hoisting his tail vertically on end and by a more sprightly lifting of his legs. This perpendicular raising of the tail, as an emblem of pride, must be perfectly separated from the wagging of the tail as a sign of pleasure, or the distended tail as marking a feeling of suspense. Neither is it an automatic action dependent on the action of the head or any other cause on a par with the frog's embrace of its mate. The proud hoisting of the tail shows up a growing consciousness, just as do the slouching gait, the bent down head, and tail between the legs represent my little friend's shame, the semi-conscious feeling that *he* has done something of which he is certain of my disapproval. These are here not the symbols of fear, for he accognises how I am disposed towards him by the inflection of my voice. Another act of my dog that undoubtedly proves that his actions are purposeful is that he will never take his food till we have finished ours, however tempting the morsel may be which has been given him. He waits to see if there is anything yet better, and as he cannot see from the floor what is on

the table, he jumps on to a chair a fair distance off in order from this vantage ground to obtain a better oversight of what is going on. Experience must have taught this advantage, and the jump is purposeful to get that which he has learned by experience.

Many animals, and especially monkeys, have a not all too crude idea of possession and prosperity, and the dog, zealously guarding his bone, is not so very far behind in this respect. This idea of possession also illustrates an awakening consciousness in the brute kingdom. The opinion that several animals evince a certain degree of consciousness, I share with no less an authority than Prof. J. C. Robinson.

The result of this short survey may be summed up in the few words, that the higher animals only differ from man in the grade of their intelligence—and this difference is not so great considering that whereas dogs and horses can be taught to count, no aboriginal Australian can even count his fingers—that animals think unconsciously although their consciousness often awakes, and that the higher consciousness of man is derived in long descent from the lowest intelligence possible—that possessed by some of the earliest denizens of the deep which have but one sense, that of touch.

> "Even apart from the ascending grades of animals up from *zoophytes*,[1] as they are significantly named, it needs only to observe the evolution of a single animal to see that there does not exist any break or chasm between the life that shows no mind and the life that shows mind."[2]

It has perhaps not escaped the observation of the reader that with many, there is a tendency to read more, the more one has read. This may not be entirely due to the fact of an ever increasing eagerness to acquire knowledge of any kind, or even to bask in the delectation of exciting adventure, of harrowing episodes, amorous intermezzos, or farcical nonentities, or to wallow in a quagmire of turpitude and lecherous immorality, for the greatest reader is not always the greatest thinker on the literature through which he has waded, and not seldom have I come across people who could scarcely delineate what they had but a brief period prior been perusing. In such cases, the tendency to read is induced by often seeing books or other forms of literature, although, be it said, other minds may be in a library without caring one iota about any of the promiscuous literature with which the space is inundated. Another daily obser-

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[1] From the Greek ζῶον (zōon) an animal, and φῦτον (phyton) a plant.

[2] Spencer's Essay, "Mr. Martineau on Evolution," p. 377.

vation of readers, is that they ofttimes involuntarily or unconsciously look longer at one word than another, be it that the especial word is one of those most met with, or which the most rivets their attention. The reading of a book such as "Jack Shepherd" has exerted a baneful influence on many a life. The continuous thinking of any acts or series of acts leads to thinking only of these—to monomania.

> "Constant attention wears the active mind,
> Blots out her powers, and leaves a blank behind." [1]

The longer the continuation of any mode of living, the greater the ennui, the more mechanical are all deeds performed, the less is the amount of thought which is brought to bear on the individual functions of the daily routine. An omnibus driver almost unconsciously drives and stops the horses and leads them unscathed through the labyrinth of dashing vehicles, and goes on talking to the man on the seat behind him, as though that were his sole occupation. Habit itself is monomania convenient to us, and speech is the habit of using concurrently chest, larynx, mouth and tongue, and sometimes the nose. Mechanical work having in the majority of instances supplanted manual labour, no especial original thought is required or given. As a set-off against this, a healthful diversion of body and mind is essential. But in England, sport is fast becoming, if it is not already an occupation, whilst even in such a country as Germany, the greater alternatives of lively company, dancing, open-air entertainments, and more excursioning do not prevent an increase in insanity, the change being no longer novel to the race. On the other hand, in the older races of the world, the rapid strides which European intelligence has made, have had a most disastrous mental effect, for the brain not being capable of maintaining the unwonted strain brought upon it, gives way, and oblivion reigns. Even the intellectual Japanese will suffer, and insanity increase among them. Inventions bring about madness. Often the inventor goes mad and his inventions increase its spread. The greater the speed of locomotion, the speed of transmission, the more lunatics. Dr. Havelock, in his 1905 annual report of the Montrose Royal Lunatic Asylum, makes mention of two persons who were suffering from the new mental disease of 'motormania' originating in an over-taxation of the nerves by urging mechanically propelled vehicles along the highways, a variation of an ailment not rarely found among locomotive drivers. There is also everywhere a tendency to more

[1] Churchill.

sleeplessness. Neurasthenia is on the increase, and as neurasthenia increases, sleeplessness will increase. This does not signify that the intelligence is greater, for though there is more restlessness, there is less mental concentration and the senses are not so reliable. Old people, whose thinking capacity is on the decline, often sleep much less than those of more active minds. When ten years old we sleep long, and this long sleep and eye-rest are in part the reason that at this age, the power of the eye to adjust itself the easiest and the most accurately to altering distances, known as 'accommodation,' attains its climacteric and extremest potentiality.

It is a noteworthy fact that the brain of animals does not nearly so often run amuck as does the brain of man.

A few last considerations:

Our brain works harder than it ever did, soon gets fatigued, and colder feet is the result. Contrariwise, the colder the feet the more benumbed is the brain. A time of cold feet is approaching, for the earth is cooling. A cooling of the earth below a certain limit, entails loss of brain power. To bring this state of things more plastically before you, it is only necessary to recall to your mind, that during a period of intense cold there will be less water in living organisms. This being so, an otherwise comparatively unimportant physiological experiment rises very materially in significance. It is the fact, that when a nerve is severed from the body, and a current passed through it, the resistance to such current in the nerve at first decreases with decreasing humidity, but soon again rapidly increases, the drier the nerve becomes. Thus in a very much less moist and colder atmosphere the conductivity of the nerves would be less, the intelligence less.

Put all this together with the statistics of ever-increasing lunacy in some one or other form, and one must come to the definite conclusion that intelligence in all its manifold phases, including consciousness, is on the wane and becoming extinct. Nought in this universe, save probably the absolute reality, is amaranthine. Intelligence is, like all else, deciduous. It has come but to go. But its comparative evanescence will have been of use, since everything that is, is necessary—has a purpose. No living being that aye has felt or/and thought or has been conscious of feeling and thought will have felt or/and thought in vain. And, that intelligence is fleeting is to me no more saddening, than that other force communities break up to form new ones. To me personally, the conception of its transientness has a rather quietening effect; for to think that our

mental vision should so greatly be extended that I saw more strife as well as more friendship, that we should be more influenced by the eddies and whirlpools of force that encompass us than we heretofore were, that our powers of comparison having been enhanced, we should feel more pain as well as more pleasure—

> "For in much wisdom is much grief: and he that increaseth knowledge increaseth sorrow,"[1]

and that we should desire, yearn, crave, and may be, after peering through them at the infinite, hurl ourselves woundingly against the bars of finality by which we are caged in, clamouring all the while for a final peace which, in the very nature of things in eternal unrest, is an utter impossibility—oh the indescribable horror of it!

But the antithesis to this in this picture of mine:

A consciousness just long enough to permit of our accognition of our part in nature, of our kinship to the plant and our yet nearer relationship to the animal world and of our fellow-men, of a unity of the whole infinite eternal system—an epithalamium to the polygamous force-forms is audible—and then this momentarily transcendental finally experienceable quietude, this mental Nirvana, —O, the glory of it.

> " . . . of making many books (*there is*) no end; and much study (*is*) a weariness of the flesh."[2]

This present chapter is the penumbra above and below which, sharp as silhouettes, the contrasts are drawn.

Choose.

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[1] The Bible, Ecclesiastes i. 18.

[2] *Ibid.*, Ecclesiastes xii. 12.

CHAPTER III

WILL AND FREE-WILL

> ". . . Nor knew I not
> To be with will and deed created free."
> MILTON.

THIS chapter will be found essentially supplemental to the preceding one. In the last, I made employment of the terms 'voluntary' and 'involuntary' as applied to thought (*vide* p. 293). It behoves us however to try to clearly understand the actual designation of these two words! There is a popular general acceptation, and it is beseeming that it should be probed in how far this usually accepted version be in accordance with that which has hitherto been said here, and in special instances elsewhere.

To be as fair as possible, the popular notion is that:

'Voluntary' or 'conative' is that attribute of an act which is conceived of as caused by the will only and to which we are willing.

Not only must the act be willed, but it must be freely willed without the co-operation of any sort of compulsion.

'Involuntary' or 'contra-conative' is that attribute of an act which is conceived of as taking place independently of the will and as the result of component causes in which the will has no part or share.

Popularly, there is yet a third category of acts carried out by man —and by some, accredited to animals—which are non-voluntary.

'Non-voluntary' or 'aconative' are such acts which are brought about by such component forces as act diametrically opposingly to the will-force and overcome it.

Have these definitions helped the reader much? I fear not, for does he or she know the meaning of the expression 'will.'

If the will, *per se*, exist, it is no mystic nor occult agent, it is a force-form: since all being force, that which emanates from force must itself be force. But does it exist?

"Of course it does. Why! I will things every day and every hour of my life," I can imagine some one ejaculating. "I exert my

will to get all I want, so naturally I have a will," calls out another; "although," continues the latter somewhat more pensively, "I do not always get what I want or will."

What a chaotic jumble of notions is manifested by these rejoinders! What sort of force is the 'will' supposed to be?

According to exclamation one, the will is something inside a person but acting entirely independently of the person or the more distant environment, a power perfectly arbitrary in function, employing the body as a means of satisfying its humours or to further act on the environment.

Now it has long since been shown, that all force-forms interact on each other, therefore an independent despotically acting force cannot exist. All force-forms not only act on, but are acted upon. At this stage of our investigations, it can be said that if a will exist, it can at all events only be in evidence as the resultant of other forces.

On the other hand, cannot a force arising from another force possess individuality?

As we cannot possibly know the whole absolute reality, we can only conceive of separate force-forms, and these forms have been shown to be inter-dependent. *No force-form can therefore in nature have absolutely its full effect.* Every force-form is therefore more correctly, the resultant of several forms, so that the last question might with more perspicuity be stated: 'Can a force-form originating in the co-operation of several force-forms, itself possess individuality?' Replication: 'No.'

Every resultant partakes of the nature of its components. And when force-complexes assume the material form, these material forms retain the combined characteristics of those forms to which they owe existence. In this wise, when a protoplasmic cell is formed, it partakes of the joint natures of certain parts of the environment. When living cells multiply by budding or fission, the cytoplasm of the cell divides by simple constriction, and its nucleus by a 'partitive' or distributive separation, owing to a peculiar 'field of force' being set up in the cytoplasm which may be likened to that of two isolated magnetic or electrostatic poles of force;[1] but in each case, the nature of the new animals or daughter-cells is that of the

[1] *Vide* a lecture by Prof. Marcus Hartog, D.Sc., given before the Hampstead Scientific Society, Jan. 6th, 1905, and epitomised in the Annual Report of the Society. The Professor exemplified the cell division by a photograph of a worm's dividing ovum, and one showing a layer of an admixture of glycerine and iron filings above two diverse poles of two perpendicular magnets.

parent. The young daughter-cell, immediately after separation, can be considered as a component and the environment as another component; and the adult cell, soon itself to become a parent, is the resultant of the two components and partakes of the nature of both. It is no individual, but composed of two parts of known propensities. In a similar way, when there is a fusion of the two cells to one, as seen in the origin of malarial fever or the trypanosomes which occasion sleeping-sickness, the result is an organism with the characters of both the parent cells. It has no absolute individuality in the sense of having a character perfectly at variance with its ancestors. Neither can it gain an absolute individuality, for it too, takes upon itself the nature of its environment. It develops nothing quite original. It is indeed an individual, if such word mean something living and moving in an environment of its own and therefore out of immediate contact with any other living organism, but with the exception of this limited signification, in the broader acceptation of the term, individuality is non-existent, the cell neither spontaneously generates nor gradually develops any traits which are not resultant traits, its every movement being dependent on hereditary qualities and environmental stimulation and accretion—it is never in any direction fully and absolutely unconnected and disassociated from its surroundings. And the ovum or female cell, which is fertilised by the sperm or male cell, gives birth to a compound cell, which contains in equal proportions the germ of the female and the male plus the environment, and is therefore only an individual in the very narrow application of not being in strict contiguity with the larger organisms of which the spermatozoon and ovum formed parts and to which therefore in the second instance it owed its nativity. Thusly we ourselves, a combination of cells, are not in the broader sense of the word 'individuals,' but are dependent on our ape progenitors in a direct line of descent from *Pithecanthropos erectus* (two petrified skulls of which, found by Dubois in Java, are in the British Museum) and, according to Prof. Haeckel, also *Pithecanthropus alalus*, whose very blood, as Paul Uhlenhuth has amply demonstrated, still circulates in our veins,—a fact which has been acknowledged by the adoption of Uhlenhuth's principles which have been utilised forensically in murder trials in the courts of justice of Germany, Italy, Spain, Austria, Roumania, Egypt, Holland, and the United States of America.[1]

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[1] *Vide* art. 'The Blood-relationship of Man and Apes,' in "The Monthy Review," No. 67, April, 1906; pub. John Murray, London.

Mathematical and social considerations may compel us not to eliminate the abstraction 'individuality' from our mental register; but we must ever remember that except only as an abstraction to be logically made use of, and taken strictly and absolutely, *i.e.* here as a reality, **individuality is an illusion**.

And here, before going further, it may be as well to cast a passing glance at the ethical aspects of the statement 'No force-form can in nature have absolutely its full effect' (*vide* p. 317). There is a rider hereto.

In a narrow sort of way, and by a most exoscopic treatment of the phenomena of the universe, it may perhaps in the abstract be said, that action and reaction are equal and opposite; but true theory is true to nature, and as in nature no force can have its full effect—it being under the influence of all other forces, so can no action have its full effect nor is the reaction fully and absolutely equal and opposite even to that much of the act which actually took effect. *No one is meted out, either in the usual course of events or by his fellows, absolutely the exact and adequate reward for a good deed nor the precise punishment for a bad deed.* ***Absolute retributive justice in the universe is an illusion.*** The bad are often rewarded, the good are punished.

Number two's exclamation (pp. 316-317) is seemingly a silent acknowledgment of an acceding to the statement that the will, as a force, is acted upon by other forces, for, says he, he exerts his will. Then there is, according to him, a force within himself which arouses or forces the will, the will being subservient to this force. Where are we coming to? We shall at this rate soon arrive at a series of mental forces as enigmatical and just as illogical and impossible as that already cited more than problematical ether series.

We saw in the last chapter, that the acts of the lollards and dancing maniacs were reactions of thoughts. The thinking forces had these acts either as resultants or reactions. When the entire congregation of any church is seen in a sudden act of genuflexion—it is a most imposing sight in a Jewish synagogue on the day of Atonement—any outsider finds it remarkably difficult himself to refrain from genuflexture. Eye and ear are so attacked, that a certain amount of force is necessary to prevent one's self being overpowered and brought to bend the knee. The tendency of the place is to force one down, and the only thing which can possibly prevent one being borne to the ground, were the greater mental impression, obtained through heavy and long thought on the subject, either that

this self-humiliation is wrong, or that it is absurd to bow to a non-existing deity. Many people are forced to do that in which they have no belief, by them feeling that they cannot be happy, be successful in life, or satisfy their sense of desideration, if they do not give way to environmental influence. Numbers would not go to church, chapel, synagogue, temple, or mosque, were it not out of respect for some one they dearly loved, or for immediate or future financial or social benefits thereby to be obtained, or to prevent any unpleasantness. The thought of a chasm is so overwhelming, that one does not will to go, but is drawn over the precipice. The fascination of beauty, of sex, of words draws one onwards. It was the influence of the masses, that forced the clergy of England to think and then so to act against their own preconceived principles of morality, that they gave the last and highest honours to the actor Irving who had lived for long years away from his wife, by burying him as a moral hero in Westminster Abbey, instead of as a stage luminary within, say, the precincts of his own theatre, or some other public place frequented by votaries of Melpomene and of Thalia. Other men, for an hour of forgetfulness, are ruthlessly and shamelessly branded for aye. They were geographical and ethnographical considerations which influenced the French and English to condone immorality in the person of the chieftain Lerothodi (*vide* p. 3). It was the moral force of the great naval achievements of a Nelson which has endeared him to all Englishmen, which made them give him too, a public resting-place and a yet grander monument in England's metropolis, despite the fact that he dishonoured Emma, Lady Hamilton,[1] the wife of one of his intimate friends, Sir W. Hamilton, a deed which cannot be sufficiently palliated on the paltry plea of Lady Emma's little amorous pre-nuptial escapades. She herself appears to have been an irresistibly attractive force, for Nelson was otherwise morally strong and failed only in this one instance to distinguish what was and what was not his duty. He knew his duty to his fellow-men, to his country, to his God, and yet he dared breathe the to him sacred name of God to Emma when he writes her, "Your friend Nelson will acquit himself as he has been used to

[1] The complete truth as to his daughter Horatia's birth has now been placed beyond doubt by the recovery of the long lost love letters of Nelson, now in the Egerton and Morrison collections. In one of these, dated October 6th, which the "Daily Mail" (October 21st, 1905), who published it, calls (let us hope facetiously) "a *noble* (?) letter" (the italics are mine), stands: "for what greater reward could the country bestow than to let me come to you . . . . and the rewards I know from experience would be beyond what any person except yourself can give." The "Daily Mail" too, is under the spell of its environment—the public, and so on. All of us no doubt have some one or other weak points. But are these noble? 'Call a spade a spade.'

do, and the blessing of God will attend him." Nelson felt the contradiction, for he writes of himself:

> "A heart susceptible, sincere, and true;
> A heart by fate and nature torn in two.
> One half to duty and his country due:
> The other better half to love and you."

And as a crowning instance of the compelling force of environment, witness the lasting effects of Jewish education and bringing up which left their impress on the brain of Jesus, the most moral man of any age. Not only does he consider Abraham, who deceived one of the Pharaohs of Egypt[1] and Abimelech King of Gerar[2] by passing his wife off as his sister and actually accepting presents from both because of her[3] and thus putting her twice in a morally more than compromising situation, and who begat children by his bondwoman[4] and by his concubines[5] (customs, which although existing, and therefore not evil, in Abraham's day, were no longer deemed moral at the time of Jesus, nor compatible with his own version of godliness), to be a laudable example to hold up to his followers:

> "If ye were Abraham's children
> Ye would do the works of Abraham,"[6]

but he is himself caught teaching that which was diametrically opposed to what he really desired to have inculcated. This grandest of reformers, for whose character I cherish the very highest veneration, who was in general so against the Hebrew principle of "an eye for an eye, and a tooth for a tooth" and who substituted for it,

> ". . . . whosoever shall smite thee on thy right cheek, turn to him the other also,"[7]

this self-same man, propounds:

> "For all they that take the sword, shall perish by the sword";[8]

or

> "He that leadeth into captivity shall go into captivity: he that killeth with the sword must be killed with the sword."[9]

He could never perfectly rid himself of that in which he had himself received instruction.

However great the fancy or imagery, such fancy or imagery is always a compound of parts of old realities or old conceits. There is

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[1] Bible. Genesis xii. 11, 12.
[2] *Ibid.*, Gen. xx. 2.
[3] *Ibid.*, Gen. xii. 16 and xx. 16.
[4] *Ibid.*, Gen. xvi. 4.
[5] *Ibid.*, Gen. xxv. 6.
[6] *Ibid.*, St. John viii. 39. *Vide* also St. Matthew viii. 11, Romans iv. 1-4, etc.
[7] *Ibid.*, St. Matthew v. 39.
[8] *Ibid.*, St. Matthew xxvi. 52.
[9] *Ibid.*, Revelation xiii. 10.

no absolute originality of thought even in the wisest of men. However much he may be in advance of his times, he must ever draw in greater or lesser degree on the past. There is an ancient Hebrew proverb:

מתוך הויכוח יתברר האמת: "By means of discussion, the truth will be elicited."

Absolute truth of course is unattainable; but temporary truth, if I may so express myself, *i.e.* that for the nonce conceived to be the truth is, and it is on this principle that the present work was constructed. The truths herein expounded are an amalgamation of older truths which have been chosen (after discussion) from out a heap of untruths (as attested by results, for only that which is accepted is wisdom and that which is discarded is folly). How very much both teacher and pupil, philosopher or reformer and public are guided by the past is very prettily illustrated by the following apologue from the Hebrew classics.[1]

"One day a somewhat too precocious Persian called on the wise man (Rab) and declared himself willing to learn the sacred language and the holy law. The kindly master sets to work and begins: 'This letter is called Aleph.'

'Aleph? How can you prove to me that it is called Aleph?' spitefully interrogated the Persian.

'O, my God!' continued the master. 'See here, this second letter is called Beis.'

'Beis?' said the unintelligent scholar in the same tone. 'Prove to me, that this letter is called Beis!' Hereupon the master loses all his patience and drives the man forth.

The Persian appears before the learned Samuel, utters the self-same preliminary, and as soon as the lesson has begun, he begins again with his joking questions. 'Prove to me,' said he, 'that this letter is called Aleph, and the other one Beis.'

Hereat, Samuel seizes the ear of the Persian and squeezes it as hard as ever he can. 'Oh dear! Oh dear, my ear!' cries the Persian.

'Thine ear!' says Samuel. 'Prove to me that this is called an ear!'

'What an extraordinary question!' replied the Persian. 'All people call it thus.'

'Very good,' was the closing remark of the master, 'and in a similar wise all people call these letters thus. Does that suffice thee?'

The Persian became very willing and continued his studies with much success."

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[1] Midrasch Koheleth pag. 102*a*.

It is only necessary in the above narrative, to make mental substitution of the public for the Persian and a philosopher or reformer for the Rab or wise man Samuel.

It is not requisite to be a learned exponent of the intricacies and all the petty subtleties of ecclesiastical polemics, to at once perceive that **the orthodox doctrine of dyothelism**—if and wheresoever it be truly believed in—**is an illusion.** Only one will was possessed by Jesus. This will was a dependent one and therefore the monothelitism [1] of the Mardaites or Maronites of Lebanon in the 7th century was an illusion, as it attached not only will to the personality of Jesus, but a divine will, thus raising him to a god. There is no personality in will (*vide* pp. 318-320). Monothelitism would therefore also then be an illusion, if it confined will to the person of Jesus or to any other person or animal. Will is possessed by animals and persons alike; and, as in the case of suggestion, a person or animal devoid of all choice of action can be willed by another. Even that other is the slave of environment and is forced to exert influence on another.

"It is not of him that willeth."

But are the above examples a type of all so-called voluntary actions? Are there no actions which are not so influenced?

Except the few, whom we call ill because they suffer from anæsthesia or absence of sensation, most people and animals have normally to endure æsthesia or sensibility. Æsthesia can consciously be enhanced, as when, after several days partaking only of lemon juice, the skin becomes so very sensitive that the slightest touch of a feather will make it red. The drug mescal makes sensitive to colour. It is in virtue of our æsthesia that we think, for we can think but of that of which our senses have given us evidence (*vide* pp. 289-292). Some thoughts appear original, but will on analysis be found to be but distortions of that which has in some or other wise been sensed. Thoughts not caused immediately by the senses, are induced by other thoughts. We think as we must. We can only will that of which we can think. Nothing of which we are in ignorance, which we cannot conceive, nor of which we can form any idea can be willed by us.

We therefore will as we must.

Edwards defines the will as

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[1] Derived from Eutychianism (the teaching of a Constantinopolitan monk Eutyches in the 5th cent., that God's nature, *i.e.* God Himself was crucified by and for men—*i.e.* man had an advantage over God. How absurd!), and mentioned by Schaff ("Christ and Christianity," p. 62), Hooker ("Ecclesiastical Polity," v., 48), and Isaac Taylor ("The Alphabet," i., 292).

"that by which the mind chooses anything."[1]

Varying slightly from this, Locke says that

"The will signifies nothing but a power or ability to prefer or choose."[2]

Now the exact influence by which the mind chooses anything is seldom known to us. Locke is decidedly wrong, for will is not the *power* to choose. It is the choosing. But here, to prevent confusion, it cannot be too clearly impressed, that my employment of the term 'choosing' is here only that of the thought of choosing. There is no act of choosing. An act of choosing is a volition.

Mansel therefore correctly defines

"A volition is an act of the will,"[3]

i.e. an act of choosing, since choosing shall herein for simplicity be held synonymous with willing, although I shall try as far as may be to differentiate between the words 'choice' and 'will.'

The power to will is the power of thought or the powers which govern thought, but neither thought nor those forces which govern it are will. Locke and others seem to have been of opinion that willing a thing and getting it are one and the same thing. But not so is the fact (*vide* pp. 327-331). The mind can will and yet not be able to perform, and may choose to have a certain motion made and yet not be able to bring about that motion.

More correctly therefore, according to present lights, *the will is the mind's choosing of anything.*

If any think that will should be defined as the 'choosing' or 'refusing,' I am momentarily content with it; though I think that it is sufficient to say it is the choosing of the mind:

> "for in every act of the will whatsoever, the mind chooses one thing rather than another; it chooses something rather than the contrary, or rather than the want or non-existence of that thing. So, in every act of refusal, the mind chooses the absence of the thing refused; the positive and the negative are set before the mind for its choice, and it chooses the negative; and the mind's making its choice in that place is properly the act of the will; the will's determining between the two is a voluntary determining, but that is the same thing as making a choice. So that whatever names we call the act of the will by, choosing, refusing, approving, disapproving, liking, disliking, embracing, rejecting, determining, directing, commanding, forbid-

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[1] "Freedom of the Will," p. 1, by Rev. Jonathan Edwards, President of the College of New Jersey; pub. Thomas Nelson, London, 1855.

[2] "Human Understanding," John Locke, ed. 7, vol. i., p. 197.

[3] "Mansel's Metaphysica," by Mansel, p. 171.

ding, inclining, or being averse, a being pleased or displeased with; all may be reduced to this of choosing."[1]

As we will as we must, we therefore choose as we must.

Choice, choosing, willing, and will have all in the usual acceptation of the terms, become illusory.

But as these expressions have till now been in use, their elimination would be fraught with much confusion: for they evidently stand for a something, of which may be up till now we have had but comparatively hazy notions. It is therefore incumbent upon us to find out that which they actually do express, and in this latter sense alone to make employment of them.

We think as we must, and as choice is a form of thought, the choice is dependent on the thought and both are governed by exterior forces (*vide* pp. 101, 102, and the last chapter). To state that a certain object is preferred, that a special course of action has been decided on, is literally naught but an asseveration that a force-tendency exists in the direction expressed. As, excepting may be in the hypnotic state, the spoken word is accordant with and the representation of the mental condition *pro tem.* obtaining, preferring or choosing is indicative of a tendency of thought in a given direction. But it was in the last chapter shown that there exists unconscious thought, and unconscious thought cannot choose. Conscious thought chooses, or rather, expressing myself, as I am now able to do, in absolute and exact terminology,

CHOICE is the result of a comparison of the probable effects of two or more mental forces (thoughts) towards or on a common centre, *i.e.* an acknowledgment ~~consciousness~~ of the probable superiority of one state over others in this respect.

Choice may be conscious or unconscious accordingly as the comparison is made by conscious or unconscious thought.

If by **end-thought** I denote that thought which represents the tendency better or stronger than other tendencies, *i.e.* the chosen tendency, then

WILL is the consciousness of the end-thought's tendency.

Will can never be unconscious.

I have thus somewhat, I hope, improved on Edwards' definition, which was, up to date, about the best extant.

Since consciousness is the philogenetic derivative of intelligence, and intelligence a series of physical actions, it follows that will is therefore

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[1] Edwards' "Freedom of the Will," p. 2.

only a special series of physical actions going on in the cerebral system. As volition is an act of the will, the act of raising my arm, to be a volition or a voluntary act, must be a conscious act or rather an act brought about by end-thought and of which I am conscious. Raising my arm in sleep or when hypnotised is not a volition, not a voluntary act.

Do you remember that on page 97 I very naïvely asked if the force to raise my hand were spontaneously generated and whether it were sufficient to explain this force by 'nerve excitements and muscular contractions'? I might have worked the problem out and perhaps got at the solution then, but there would have been much surmising, but above all, I had to be political. Although I, in a crude sort of way, just hinted at the truth on page 101, this truth would in the ordinary way have been a microbe gnawing at your peace of mind, so I had to prepare a mental opsonin and was very careful not so to place the true facts before you, that you should at the very outset of this lecture, be set dead against me. Why! dear readers, it might so have overheated and inflamed you, that you would most probably in an extremely undignified manner have slammed together the lateral protections of this tome—to your own hurt, for you would have learnt less. As it is, you have no doubt found highly delectable and palatable all the so-prepared half-truths I set before you, and have come to the end of your intellectual repast with an unimpaired digestion—and a tranquil state of mind. Only now can all the consequences be overseen, for only now are you informed that not only is there no personal power to go in a given direction; but that will, being a special consciousness, and consciousness being limited to the cerebral system, *there is likewise no power invested in the several force-forms exterior to the cerebral system to go in a given direction made out by themselves;* since lines of force or routes taken up by forces can never be straight lines, but some other form into which the forms are forced by their colleagues to enter. *Neither can the Universal Force as a whole, of which the force-forms are parts, move otherwise than as its character prescribes.* It is infinite, filling infinite space. There is no empty space exterior to it. It can therefore, as a whole, neither move in straight nor a curved line, nor for that matter in a crooked line, since the term 'crooked' entails a series of straight lines in various directions or/and planes. It can move neither forward nor backwards, neither sideways, nor diagonally, nor upwards, nor downwards, nor around in rings, nor in spirals, nor in other bendings

within space. It cannot initially move its parts: it can but suffer their internal action (which is their nature); since it cannot think, has no intelligence, no consciousness. *Neither, on the other hand, are the movements of the parts arbitrary*, for they move according to their nature, according to the nature of the forces influencing them.

We come to the definite conclusion, that not only is there no cosmic intelligence, there is likewise no basis for a theory of voluntaryism—a theory that the ultimate nature of reality is to be conceived as some sort of will—be it Schopenhauer's or any other, much less is there a supreme force exterior to nature, ruling the movements of its parts and therefore us.

To make myself perfectly clear, I reiterate: The best reply that I can give to the self-put question on page 97 as to what force raised my arm, is that it is a force generated by thought. It is not will, at least not in the new and absolute sense to which it has now been adapted. It is caused by nerve excitements. If there is an unconscious tendency to raise my arm or if I think unconsciously of raising my arm, there is no will. As soon as I become conscious of a thought of raising my arm, I will the raising of it. But I only succeed in so doing, when the will is sufficiently strong. I cannot get all I will, I am not sufficiently strongly conscious of every tendency of thought, that the muscles sufficiently contract as to perform that thought of. If I will to think of thinking, I am conscious that there is a tendency to think about thought, which most probably is caused by other thoughts. This willing to think, if followed by a volition—the act willed—is therefore one of the highest possible forms of consciousness.

It is probably because intelligence is a force, that consciousness of a tendency to act in a special way is sometimes followed by an act contrary to that of which there was a conscious tendency, or in other words, the thought of doing one thing was followed by an act doing the reverse, *i.e.* there was a negative thought current. This must be the case when I willed persons to sleep and found them about to spring out of a railway carriage (*vide* p. 103).

When one loses consciousness, there is a loss of will, and *vice versâ*, when there is no will, there is no consciousness. Thus, when in ordinary parlance, one will to run towards a certain goal and volition follow will, the absolute statement of affairs is that a goal has been mentally and consciously chosen—there is a strong tendency of the mind in a given direction, so strong that the body

is urged in that direction; but as yet there is no consciousness of it. Then consciousness sets in, *i.e.* one wills to move towards the goal. As consciousness gains, one obtains a consciousness of the act of running at the goal. The thought often so increases in intensity, that the momentum set up carries the body far beyond the place intended. One does not will to run too far ahead—one is not conscious of that part of the run which is taken beyond the goal. Of course one afterwards accognises or recognises that one has run beyond the spot contemplated, but this is thought without consciousness, for one is not conscious of this thinking. There gradually awakes a consciousness—semi-consciousness—that one is not at the premeditated goal, and lastly there arises a clearly defined, full and complete consciousness of where one is standing, one wills to stand there till one has thought out, made a choice—been forced to think out, been compelled to make choice—where next to proceed. In like manner, when, in a fit of anger, a man thumps down his fist with a crash on the table, the act is not willed, it is no volition, he is not conscious of it till afterwards, when it has taken effect. This is why one who loses his temper is so despised of his fellow-men. His acts are not so much looked on as an ebullition of feeling at the loss of an argument, as rather a loss of self-command, of consciousness, of intelligence. Was not Kant very near the mark, when he wrote of reason, that it was "the legislator and governor of the will"?[1]

Before going any further, it were as well to map out the present panorama. It is quite obvious that the whole public map, which divides up the territory into the three provinces: voluntary or conative, involuntary or contraconative, and non-voluntary or aconative (*vide* p. 316) is obsolete and useless. There are whole tracts which have changed hands.

There are acts of ours of which we are not only conscious, but of which we are conscious that we are the actors. Thus, I can write a letter and be conscious that *I* am the writer; that others, may be, are looking on at me writing.

There are actions of which we are conscious, but of the personal doing of which we are unconscious. Thus, I can be conscious of writing a letter, but yet be so engrossed (influenced by) the subject, that my personality, as set off against others, is entirely lost to consciousness.

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[1] *Vide* Kant's "Metaphysik der Ethik."

A letter can be perfectly unconsciously written, as when I write one which demands of me comparatively little mental effort, permitting my consciousness of an absorbing conversation which I am contemporaneously carrying on. Or I can be looking for a word in the dictionary consciously, and turning the pages unconsciously. On the other hand, I may unconsciously (involuntarily) gape, shudder, or move my eyes. This waking unconsciousness is a similar one to that of the somnambulist, or that of a hypnotised person, or one under the influence of alcohol or drugs; but the cause is different. I may be unconsciously (non-voluntarily) bodily moved by another, whilst sunk in deep thought or during sleep.

There is however another category of conscious actions—those of which we are not only conscious that we are the actors, but that we are being forced thus to act. I may be conscious of my arm being moved up or down by a person or machine. I may be conscious of walking and simultaneously of having been sent out for a walk, *i.e.* am conscious that the walking is a compulsory act. I can in fact in extreme cases, in each individual action undertaken, be conscious that such action has directly or indirectly been guided by exterior influence. Such retrospection would convert most voluntary into non-voluntary actions. Thus I can involuntarily (unconsciously) gape, but during gaping, become conscious of the act and even set trying (a mental force is consciously exerted) to close my mouth; but become conscious that I cannot, as the force exerted to open the mouth is greater than the force to close it,—the gaping has become contra-voluntary. Retrospection itself is involuntary.

Five provinces will have to be mapped out:—

I. **Voluntary acts:**
those brought about by end-thoughts (*vide* p. 325), of which we are conscious, and of which we are conscious that we are the actors.

II. **Semi-voluntary acts:**
those brought about by end-thoughts, of which we are conscious, but where no distinction of personality is entailed.

III. **Involuntary acts:**
those of which we are unconscious, and which are produced either by

(1) unconscious thought { (*a*) whilst awake / (*b*) whilst asleep }
(2) food or drug
(3) other external stimulations { (*a*) reflex actions / (*b*) tropisms }

IV. **Non-voluntary acts:**

those of which we are unconscious, and which are produced by

- the force of another person or animal
  - (*a*) corporeal exertion
    - (α) *directly*
    - (β) *indirectly per other person, animal, or inanimate object*
  - (*b*) mental influence
    - (α) *persuasion*
    - (β) *hypnotism*[1]
    - (γ) ~~*telegraphic*~~ *agency* telepathic

V. **Contra-voluntary acts:**

those of which we are conscious and that we are the actors, but of which we are simultaneously conscious that we have been forced to become the actors.

According to all the absolute definitions as hereinbefore laid down by me, 'choice' is not, in the following remarks, used to designate an act of choosing, but precedes it; being in respect of a mode of thought prior to that which contracts the muscles. Choosing, as employed by me, implies a consciousness of the moving force after having made choice. Thus, after an act of choice, after choice has been made (the mental comparison), there follows the act of choosing—the choosing.

Bearing these distinctions in mind: In all five kinds of volition there is therefore an element of choosing—they are acts that have been chosen in preference to other acts, the choice having been made either consciously or unconsciously.[2] Even in contra-voluntary acts, there is an essence of choosing; but the consciousness in this last instance is a consciousness that we are choosing as we must.

And this brings us to a study of choosing, or—as we have now learnt to express ourselves—tendency. To choose one thing in preference to another is to be conscious of a tendency in the direction of one thing more than another. There are many ways by which one can choose. These are best explained graphically.

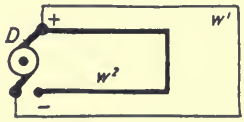

Fig. 12.

[1] We cannot be hypnotised against our will, *i.e.* as long as we have will or consciousness of tendency, but only after a loss of self-consciousness; but this loss can be caused, and this consciousness superseded by the stronger consciousness of another (will). This is hypnotism: the transmission from person to person either directly (laying hands) or indirectly (across an air gap) under conditions of very high potentiality, of the force of intelligence inclusive of its phrase consciousness.

[2] Thus, a choosing, which is always conscious, may be the result of a choice which may be conscious or unconscious.

D is a dynamo or electric current generator, from the positive (+) pole of which there are two wires, W^1 and W^2, W^1 being of lead and joined at its other end with the negative (−) pole; whilst W^2, of copper, is at its further extremity unconnected, but yet in close proximity to the dynamo pole. The dynamo-shaft is set slowly revolving, and a weak current seeks and starts to flow through W^2. This means to say, that an electric current, which is an especial motion of particles in a given direction, sets the particles of the copper wire easier in a similar motion than those of the lead wire, the copper electrons are in a state easier to be influenced by the especial momentum set up by the dynamo current than the lead ones. There is a tendency for motion to be imparted along W^2. When however, the movement has been communicated up to the end of the wire, it can go no further, as there is an air space between the wire and the generator, and the air particles are not in a condition to be easily electrically set in motion. So much so is this the case, that the motion now no longer proceeds along W^2 but along W^1, the tendency is along W^1 although the distance is longer through W^1 than *viâ* W^2 + the air gap. If the movements going on at the outset in wire W^2 be made to illustrate a current of thought, then consciousness of this current-route being taken instead of (in preference to) W^1 would constitute making choice. A consciousness of feeling in which direction the tendency lay, *i.e.* which route contained electrons most susceptible to perpetuation of the movement (most conductive—*i.e.* were the best conductors), was choice. The consciousness of an actively moving current along W^2, was choosing W^2. But no current circuit was made. Another choice was made, followed by another choosing, this time along W^1 and a movement set up in the entire system. If the arrival of motion back to the dynamo be made to represent the attainment of a goal or purpose, then the two wires may be made to depict two different tendencies in different individuals[1] for reaching it. The choice of the one is of no avail, his choosing is frustrated; whilst the choosing of the other is crowned with success. But actually, absolutely there was in neither instance any striving to get to a goal.

The idea of striving, as such, is an illusion.

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[1] The word 'individuals' is here used in the popular adaptation and not logically absolutely in respect of two persons or animals fully independent of each other's actions, which were impossible, every force in greater or lesser degree influencing every other.

There is however, to extend our allegory, another chance of W^2 winning. If of two ways of achieving anything, one be more difficult than the other, then to succeed by the more difficult way, much more energy has to be expended. In the case before us, should the leaden W^1 be coupled up with a dynamo D^1 (*vide* Fig. 13),

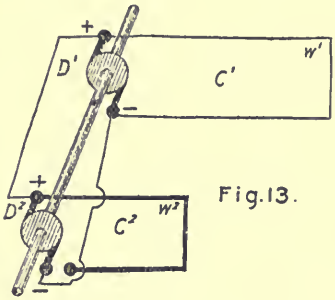

Fig. 13.

generating say 80 ampère and 100 volt (8,000 voltampère = 8 kilowatt), and W^2 to a current source D^2 with another winding, giving 5 ampère and 1,600 volt (8 kilowatt), and both generators be on one revolving shaft, then there is a tendency from D^1 of 8 kilowatt just sufficient to send a current through the given long length of lead wire, whilst simultaneously, the tendency from D^2 along W^2 likewise of 8 kilowatt, is of such kind that it is not only enough to overcome the electrical resistance of the air gap, but to course the copper circuit quicker than the lead one, with the result that most of the current of the system will be deviated towards the circuit C^2 instead of C^1, and circuit C^2 will be able to do more work. This is an illustration in the choosing of methods in competition. The salient point to be fixed, is that there is actually no striving and no competition.

This subject should not be closed without taking its ethical aspect. Sir Oliver Lodge[1] has said that

> "inorganic matter is impelled solely by pressure from behind, it is not influenced by the future, nor does it follow a preconceived course nor seek a predetermined end. . . . . The intangible influence of hunger, of a call, of perception of something ahead, are the dominant feature . . . . of an organism animated by mind."

Sir O. Lodge is one of the few men in England who have the courage to give open vent to their opinions. This, however valuable an acquisition, is in the present instance trebly to be lamented. Firstly there ought to be more men who are brave enough publicly

[1] *Vide* his art. in the "Hibbert Journal," p. 328.

to confess what they inwardly think; secondly, Sir Oliver being one of the few, is generally accepted as an infallible authority on nearly all the provinces of philosophy; and thirdly, knowing himself thus esteemed, and, may be, feeling himself incompetent to tackle all subjects with equal ability, he attacks them with the subtle wisdom of the Sphinx, with the result that his sayings and writings are often misleading (not perhaps intentionally) and not a little ambiguous. Let us analyse Sir Oliver's above statement. Is it our experience that 'inorganic matter is impelled solely from behind'? How about the attraction of iron filings to a magnet? How about the chemical affinity of one body for another, drawing it unto itself, or the second body being attracted? Are these not forces in advance, ahead? In this sense, inorganic matter is distinctly influenced by a future, although of course, unconscious of the fact. Sir Oliver says that inorganic matter does not 'follow a preconceived course nor seek a predetermined end.' Granted; but man does little more. Because of his intelligence, which is purely mechanical (*vide* the last chapter) he can discern the course prior to being in it (he can preconceive or rather, to be more accurate, form an idea beforehand); but, as this chapter has to sufficiency proved, man has no design, cannot determine, cannot seek nor strive—he is only conscious of the current in which he momentarily finds himself. Man has senses and an intelligence which make him conscious of a tendency, but he is also shoved on from behind by this tendency and he even thinks as the tendency makes him think. He does not purposely act either one way or another, although his acts, like all else, even of the inorganic world, have a purpose.

It is of course impossible to conceive of the tendency verily obtaining, but yet the graphical method may again materially assist us.

For the sake of example, the individual shall be represented by a drop of water in a strong current. *AA* is a broad water-conduit (*vide* Fig. 14) with a strong current flowing in the direction indicated by the arrow *d*, and in which a single drop *a* (magnified) is being driven along. Let into the main *AA* are two water systems *B* and *C*, *B* having its downwardly inclined aperture at a smaller angle to the horizontal than *C*. In *B*, three pistons and their rods force water through the three cylinders D, D^1, D^2, with forces of respectively 4, 3, and 2 horse-power. Water is forced through *C* at 2 horse-power. Let us imagine that our drop *a* had started from some exterior source and been pumped through *D*. Then the general current tendency,

whatever may be its nature, were in the direction *g*. This is, viewed from *B*, the correct or good tendency; but viewed from *AA* a bad tendency, and from *C* a nigh diametrically opposed or revolutionary tendency. Our drop has however a hard time in deciding which is the direction expected of it (the good tendency). It is, at the outset, in spray *b* and may be driven straight on or forced against the walls, thus moving in the line *f* after being hurt, or lastly either tossed into a whirl between spray *b* and b^1 (become vacillating) or get into spray b^1. Here it may either move towards the orifice or move on to spray b^2. In any case, if we imagine our drop conscious

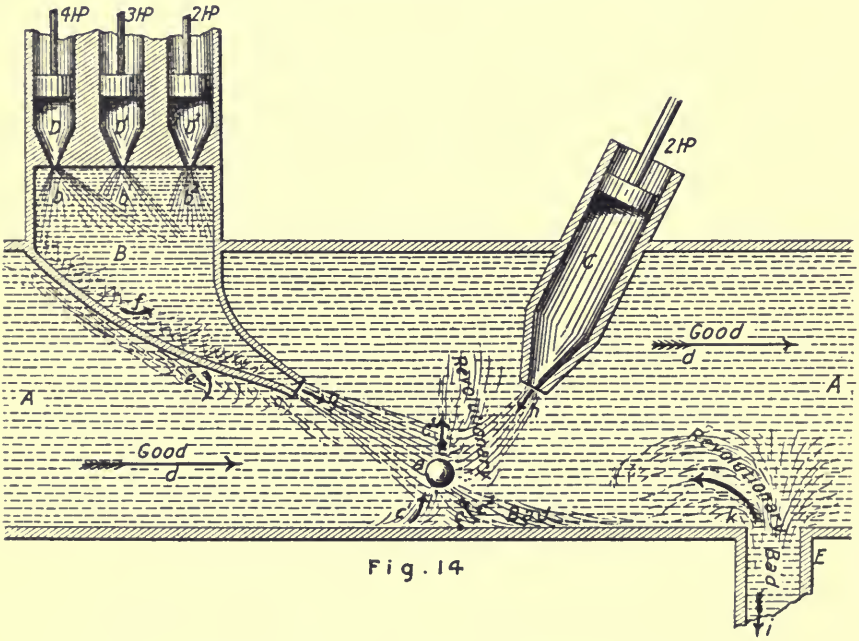

Fig. 14

of its actions, it believes itself right in whichever direction it may be going, for it is only conscious of that tendency driving it, *i.e.* it willed to go in that direction after thinking that it was for itself the best—and self-preservation is the first law of nature (at least it thinks so). How different are these ideas from Haeckel's conception of a living protoplasm self-striving after its own perpetuation. Our drop next emerges from *B* and is driven downwards towards the point *c* (rightly, according to the drop—wrongly, according to other drops running in the direction *d*). Now many things may happen. There is a small pipe *E* leading downwards. *a* may either be sent flying along *AA* in which the current *d* is say 12 horse-power, aided by a suction action of water at *E* running towards *i* (it sees a future

ahead, which it thinks right, but which is caused by and leads to evil) and gets in *E* into bad company; or having got into a current c^1 and for the nonce thought of going wrong, thinks the better of it and at a higher level is carried along *d* far beyond *E* (he has become a really good little drop); or it mounts along c^2; or is driven back by *h* (becomes bad or even revolutionary and wicked); or be made to vacillate in an eddy caused by *d*, *c*, c^1 (through striking the wall) and *h*; or our drop can be tossed till close to the right of *B*, in which case it gets into a calm [1] from which it may, during its existence, never be able to return, but it is quite content, it troubles about nothing, and nothing troubles about it, it is no longer swept along in the turbulent currents of its time; or lastly, after being in the good current (which forced him, poor fool, to love those who were carrying him along) and felt pleasure to his drop's heart's content, he can get thrown off by his whilom friends, cast against the sharp corner where *E* emerges from *AA*, and be so pained that he resolves (feels forced) to revenge himself and so starts on a career of crime along *k*. Here ends the tragic story of the peregrinations and multitudinous vicissitudes of our drop of water *a*, who, for good or evil, remained slave and the plaything of his fellow drops, being sometimes, it is true, taken with as companion, but, more often than not, roughly buffeted from one to the other or thrown boisterously against the hard unyielding rocks of a relentless necessity—the sides of the water conduit. They hurt him. He hurt them. How seldom it is that a perfect calm is reached,—no shoals, an imperturbable tranquillity of mind, unaffected by the storms of life, by the tempestuous seas of adversity, and undisturbable by the cruel waves of conflicting opinions! Such a haven is for the most of us but a consummation much to be desired, never to be attained. We are ofttimes near it, see it; but at the last moment are, despite ourselves, hurried on—whither, oh whither?

We are forced to do wrong and forced to do right. When we have been rewarded for our good deeds, the rewarder was forced to reward. Should we do wrong, we should probably be punished either by those around us, or, for a grave offence, by those who compel compliance with the laws of the land. These laws they are naturally constrained to have respected. Be they kings, or a House

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[1] There is a similar calm area to be found in nature, *i.e.* in the Gulf of Mexico. It is two miles long by three-quarters of a mile broad, lying to the S.W. of the Sabine pass, and is known as the 'oil spot.' In the greatest gales that rage outside, this piece of water within, maintains its sublime placidity.

of Lords, or judges, or their subordinates, they are naturally bounden to enforce obedience to the constitutions of the realm. When children do not obey their parents, or men the laws of the land, they are punished. But they are incapable of acting otherwise than they do. Yet the punishment is just and right if the command came from just parents or a just government, for the just parents and government are in the so-called good tendency current, whilst the disobedient children or men are in the eddy (bad or revolutionary current). The punishment may or may not lead the disobedient ones into the main stream of good (to reformation); but at all events, the punishment of the few, acts on the majority, their neighbours who are weak, as a deterrent. They fear punishment and keep to the course of good. The punishment becomes part of the course maintaining the high moral tendency. But as to what is good, the word being relative only, the trend of society contemporary with the chastened ones, decides. It must be felt that the force of good is the greatest force, and that any exertion contrary to this force means pain. These are signs of ethical tendency. Ethical tendency, existing and being real, is a necessity; but bear in mind, please, that all necessity is natural necessity, *i.e.* the result of natural causes, since all is natural. There is no such thing as moral necessity apart from natural necessity; but it can probably coëxist with this.

"Noch niemand entfloh dem verhängten Geschick,"	"No one yet has escaped the allotted fate,"

says Schiller, and in a way he is right. He is in so far right, as every cause has its effect, and each effect becomes a cause; and thusly, every effect—and we too are in a sense effects—owes its existence to its cause and lasts as long only as the cause lasts. Is the cause annihilated, so is the effect extinguished. Likewise, the effect itself is during its stay, on all sides assailed by the several parts of its environment, themselves effects and the results of causes to infinity; so that in no wise can it possibly throw off its trammels and escape. But I take exception to Schiller's use of the word 'verhängt.' It implies that there is a power capable of preordaining, which, in its turn, entails intelligence. There is no cosmic intelligence, *i.e.* an intelligence exterior to our own, and therefore **there never could have been any preordination—it is impossible.** *Fate, in the sense of an existence planned in advance, is an hallucination of the ancients* (inexperienced children of the world, in this respect),—*an illusion, when believed in, of the present generation.*

How much more sapience is discernible in Seneca's apothegm,

"Ducunt volentem fata nolentem trahunt,"[1]	"Fate leads the willing, and drags the unwilling,"

and which has now passed into the popular aphorism, 'fate leads the willing and drives the stubborn.'

How near too, to my own ideas!

Fate, here, is but a current carrying one along, and even an apparent reversal of action is not really so. Contrary actions are phenomena not *noumina*. The current is seen running from left to right in Fig. 11 (*vide* p. 256), and yet parts of it, running from right to left, are being dragged along.

But man can ever only have a knowledge of phenomena and thus 'the venerable one' of China, Laou-tsze,[2] had wondrous insight when he wrote :—

"Taòu k'hò taóu fei ch'hang Taòu.	"The way[3] (*tendency*) which can be put in words (*expressed*) is not the eternal way (*tendency*).
Mîng k'hò mîng fei ch'hang Ming.	The name which can be named is not the eternal name.
Woò ming, t'heen té che chè	Not nameable is the former of sky[4] and earth ;

[1] From Cleanthes.

[2] Or Li-pe-yang, born in the province of Honan B.C. 604, and in his old age the contemporary of Kong-fu-tsze (Confucius).

[3] It is remarkable that most people try to put their own ideas into a translation, and sometimes in a very unfair way. Thus, wanting to find a god in the old Chinese beliefs, Père Amiot, Abel Remusat (Jesuits), and following in their footsteps Stanislas Julien (1842, French), Rheinhold von Plaenckner (1870, German), Victor von Strauss (1870, German), and Major-General G. G. Alexander (1890, English) refuse altogether to translate the word Taòu, thus making it a proper name, and made to stand for some sort of deity. But the word means either 'the way' or 'reason.' Very likely, the old Chinese inductively obtained these two significations thus: the way, the cause, the reason.

[4] The Germans have rendered this word by 'Himmel,' having but one word wherewith to express 'heaven' and 'sky'; but Major-General Alexander, who knows that heaven is the name given to the abode of a divinity, has no excuse, yet purposely uses this word although the Chinese word is more correctly rendered by sky. Missionaries do exactly the same when they translate the Ainu* word 'Kando' as heaven instead of sky, although these Ainu, having no god, cannot have a heaven. The word 'kamui' which they use as regards anything peculiar, gigantic, or which they do not understand, does not mark these people as polytheists, as it only means wonderful or ancient (*vide* Landor's "Alone with the hairy Ainu").

* The Ainu, a hairy race on the Island of Yezo, Japan.

Yèw mîng, wan wŭh che moo.	Whilst it, the nameable, is that whence all (*known*) things come.
Koó ch'hang woô yŭh, è kwán k'hê maou	Hence he who would have ken of this great (*unknown tendency*) must keep aloof from fleshy desires.
Ch'hang yèw yŭh, è kwán k'hê keaou	Who gives way to passion will not see beyond the senses' limit.
Tszè lëang chay, t'hung ch'hŭh ŭrh é ming.	Yet both (*the unknown and the known—force and matter*) issue from the same source,
	Though both be (*exist*) yet are differently named.
Thûng weiche heuen, heuen che yen heuen Chung maou che mûn.[1]	The source of both is equally dark, for dark are the entrances through (*to reach*) to the unknown.

Is it not thus that I conceive? Is not "Taòu k'hò taóu . . . . Mîng k'hò mîng" the veritable reality, earth and sky "and all that in them is,"[2] that which can be explained and which can be given names, the way or tendency felt by the senses and which intelligence can comprehend, but which being mutable, 'is not the eternal way'? And that which we do not see, the unseen forces which are the cause of, 'the former of sky and earth,' the force, the tendency, the way that brought that sensed by us into being—"Woò ming" 'not nameable is it.' Nor is the greatest of all problems, that of the hither and whither of the universe as we know it, solvable, although we, with Laou-tsze, have seen this much: that force and matter are from one source, from out this vast tendency, at which we cannot even peer, for it flows silently and obscurely along its bed in the tenebrous depths of infinity.

"Jŭ fá tè	"Man's laws are from (caused by) earth
Tè fá t'heen	Earth's laws are from (caused by) the sky
T'heen fá Taòu	The sky's laws are from (caused by) the way (tendency)

[1] From the twenty-first chapter of "Taóu-te-King," a work of eighty-one chapters, the chief work of Laou-tsze.

[2] Exodus xx. 11.

Taòu fă tsze jèn.[1]	And the ways (tendency's) laws are its own (self-contained);

and, that all doubt as to his meaning may be put aside, Laou-tsze himself continues:

"Wuy hwang wuy hwŭh	"Nothing but a chaos,
Hwŭh he, hwang he	How deep, how drear.
Ke chung yèw sëang	Out of its midst came forms (shapes),
Hwang he whŭh he	How cheerless, how profound.
Ke chung yèw wŭh	Out of their midst came substances (material objects),
Yaou he ming he	How still, how dark.
Ke chung yew tsing	Out of their midst came germs of life,
Ke tsing shin chin	Perfect in subtlety.
Ke chung chung yèw sin	Out of their midst came consciousness.[2]

He even accognises that consciousness put in its appearance after life had come down upon this earth.

Are we then to succumb? True it is, that we think as we are forced to think. Our intelligence is forced upon us. Our ideas, our acts are forced upon us by our environment, yet the environment, though suggestive, cannot of itself suggest. We could not, under the very self-same circumstances, have done aught otherwise than we have done it, nor shall we aye be able to think or act otherwise than we are made to. A child can only act according to its knowledge. Show it only right, and it will go right—provided always that a hereditary tendency be not in the ascendency. And that you yourselves may not go wrong, I let two men speak to you, suggest to you your future actions. Keep their words in your brain, and may they be so indelibly impressed that you ever act accordingly.

"Quiquid erit, superanda omnis fortuna ferendo est."	"All fortune,[3] whate'er betide, is to be surmounted by bearing it."

Be true men and true women, that is to say, and do not be despondent when good luck seems against you. Never be downhearted. This is the advice of the poet Virgil. The advice is not new, but still good and sound—take it. And Emerson,

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[1] *Vide* "Taóu-se-King," chapter xxv. Since this time, Taòu is the cause of the sky, it is the unnameable, the main current, the absolute reality, which we cannot understand and never shall—but it is not on this account in any sense a god.

[2] The English of these Chinese texts is an amendment of that of Major-General Alexander, C.B., in his "Confucius"; pub. Kegan Paul, London, 1890.

[3] Good or bad, *i.e.* our fate.

a man that lived in modern times, admonishes you in these words:

"It is the best use of fate to teach a fatal courage."

Courage is not incompatible with patience, therefore be patient, be courageous. 'Never say die.'

I, for my part, say with Lessing:

"I covet no free-will."[1]

I cannot write otherwise, I cannot advise otherwise than I have done.

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[1] *Vide* F. H. Jacobi's "Werke," Bd. iv., p. 61; pub. Leipzig, 1817; "Ueber die Lehre des Spinoza in Briefen an Herrn Moses Mendelssohn"; pub. 1785.

CHAPTER IV.

ID EST—NOS SUMUS.

LITERALLY taken, philosophy is the love of wisdom. "Wisdom is the right use of knowledge." The right use? Who is to say which is the right use of anything? Only the person judging, at the time of judging, and judging as he must (*vide* the previous chapter). And knowledge is based on experience (*vide* def. p. 24). Now the experience of each varies according to the time and place of observation and the conditions of observation. Thus what is knowledge to one, is only the surmise of another, or not fact to a third. Tolstoi, in his "Confession," well expresses this standpoint when he writes:

> "All that men sincerely believe in must be true: it may be differently expressed, but it cannot be a lie: and consequently if it seems to me a lie, that must be because I cannot understand it."

Tolstoi means to say that each believer, having his own point of view, his own individual experiences and special deductions, based on other phases of the absolute reality (fundamental truth, *vide* p. 62), can have a conception of transient and apparent truths, other veritable realities (*vide* p. 62) which must ever remain outside the domain to which Tolstoi himself has ingress.

If any man collects his knowledge on various subjects and formulates a set of rules as to his actions with regard to his several experiences, and such rules in respect to the varied experiences so harmonise, that in his own judgment a right action in respect of one item of knowledge does not clash with what is right in respect of the other items, then has he built up a system of philosophy—for himself. But in the course of a day, perhaps even of an hour, a flood-tide of new experiences may rush in upon him with such fatal vehemence as to wash away at one dire sweep the entire foundations, and his with such care constructed fabric, his idolised system falls shattered, crumbling to the ground.

No system is permanent, and it is therefore that I abstain from founding any system based on future conditions. I act in the living

present, *as circumstances dictate.* All my indoctrinations are of, and all I advise is for the present. Let the future take care of itself.

But every act of mine, although dedicated to the present, influences the future—every effect becoming in its turn a cause. I seek the truth of the moment, but never find it; how much less can I hope to explore the absolute or fundamental truth, the conditions constantly changing. My seeking, however, has its influence on the conditions that will obtain.

I believe that the majority of people move in a plane in which reason (*vide* p. 285) is uninterruptedly and incessantly essaying to comprehend the truth by making deductions from abstractions and to get at the character or true nature of the absolute reality, of the Kantian 'Thing itself'; whilst understanding (*vide* p. 285) only attempts to bring to the fore the things in the world of appearances (phenomena) which make themselves known to the senses—the veritable realities. Understanding does not go in quest, it grasps. Thus, one may reason on good and evil, but there fails all possibility of ever understanding it. I, for my part, have reasoned and found that all efforts to reach the paramount truths must be ineffectual and futile, that the transcendental truth, though existing, is—as far as our understanding is concerned—but a fugacious phantom, a gigantean ignis-fatuus luring treacherously into an inexhaustible source of entanglements, which in the long run must for every earnest would-be discoverer, lead to inevitable destruction. So did Spencer succumb (*vide* pp. 173-174), and there are no means of resuscitation for those who sink into these fathomless depths.

But even he who goes in pursuit of present transient apparent truths, will soon see enormous difficulties cropping up in front of him, on all sides, and find hedges—so-called 'causes of error' barring his way, hemming him in and through which he must arduously cut his way.

For the moment, not taking count of the fact that all undertaken by us is undertaken under compulsion, let us make mental note of the genus of these natural barriers.

It has been shown, that our conceptions of the universe are obtained through the medium of the senses, *i.e. viâ* the sense organs and the nerves in connection with these. The nerve currents are all on the surface of the nerve and so also is the change of tension. Thus it is that the cortex and not the brain substance within it, is the centre of our intelligence.

"Every excitement in the nerve is due to a change in its condition, which might be directly shown in the case of the electrical current by the electronic change in the excitability."[1]

Now if any exterior agent (food, drug, disease, colour, etc.) so act on the nerve as to make it less active, less easily liable to change its condition, more sluggish; then our conception varies: for one cannot so rapidly mark the transformations which go on in the environment.

"Excitement of the nerve depends on a change in its molecular condition. It occurs as soon as such a change is effected with sufficient speed."[2]

"The more quickly these changes occur, the more easily are they able to excite the nerve."[3]

If therefore, the speed of exterior variation or alternation be controlled, it likewise puts a check to our perceptiveness. On the other hand, the variations may take place at so great a velocity that our nervous system is incapable of taking note of them (*vide* p. 14).

"Nerves are positive on the longitudinal section, negative on the cross section. The greatest positive tension is in the centre of the longitudinal section." "As soon as this current is closed, all the points on the nerve on the side of the anode become more positive, all on the side of the cathode more negative than they were." "During activity, the differences in tension decrease."[4]

"If a single point in a nerve is frequently irritated, the actions become weaker after a time, and finally cease entirely. If the nerve is then allowed to rest for a time, new pulsations may again be elicited from the same point."[5]

Only those excitations therefore which are comparatively sudden[6] (*vide* p. 14) can be received and 'felt.' Thus many an action of continuous occurrence is quite beyond our ken and cognition. One can become so accustomed to the perpetual repercussion of a clock's tickings, or even to the loud whirring and rattling of machinery, that no mental record is registered. We do not fully cognise, accognise, nor always even re-cognise our surroundings.

Each nerve-cell is affected by a different amount and degree of stimulation. Thus many forces, not being able to work or act on the specific cells in unison with them, are lost to our consciousness: which, if they had been applied or focussed on to others, would have been perceptible to us. A given number of vibrations on a

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[1] *Vide* Rosenthal's "Physiology of Muscles and Nerves," p. 226.

[2] *Ibid.*, p. 152. [3] *Ibid.*, p. 226. [4] *Ibid.*, p. 226. [5] *Ibid.*, p. 123.

[6] What is sudden or quick to one person, need not appear so to another. A person accustomed to quick transit by rail or motor, becomes more used to rapidity than one in the country who has never exceeded the speed of a slow cart.

tuning-fork, according to their application, can be either felt, heard, or seen.

Rosenthal[1] says that

> "as all the nerve-fibres which accomplish the various sensations differ in no way from each other, we are forced to look in the nerve-cells for the reason of the difference in sensations."

This deduction of Rosenthal's does not appear quite correct. Accordingly as the waves set up in the nerve be long or short, the difference between crest and trough be great or small, and accordingly also to the amount, potential, and speed of propagation of the current, and temperature of the nerve, so must the nerve-cell be affected. It is hardly true to say that the effect is nil except in the instance of a special current, and that all other currents are ineffectual, for every force has its effect, be it great or small. The conclusion that "The sensations which we receive from outward impressions are therefore not dependent on the nature of these impressions, but on the nature of our nerve-cells," is only partially right, although I grant that the nerve-cells, like the cilia of the ear, may fully be influenced by one grade only. Each little hair in the ear vibrates to one sound only, and only one influence has the power of fully exciting the terminal apparatus of the nerve. Therefore our reception of different impressions depends in the main, though not entirely,

> "on the character of the nerve-cells in which the nerve-fibres end. Supposing that the nerves of hearing and of sight of a man were cut and the periferic end of the former were perfectly united with the cerebral end of the nerve of hearing, then the sound of an orchestra would elicit in us the sensation of light and colour, and the sight of a highly-coloured picture would elicit in us impressions of sound."[2]

These facts represent another class of causes of error. If, through illness, parts of the body, such as the kidneys or the liver, swell and these press against other bodily parts, say the ribs, or if, the womb ligaments relaxing, the womb sink and press upon the bladder, or if the current in any one nerve be sufficiently strong to induce a current in an adjacent nerve, then there is no knowing if or not we obtain a different sensation altogether than would have been elicited in the normal state. It is of course a recognised fact that the above failings are the cause of a fractious, splenetic, irritable, or melancholy temper, and that things are seen sometimes yellow, sometimes bluish, and at times little spots are beheld vexedly dancing up and

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[1] Rosenthal, p. 278.

[2] *Ibid.*, pp. 283-284.

down in front of the pupil. The author, when himself liverish, has had occasion to examine these spots and has actually several times literally seen an image of his own eye, *i.e.* an image, apparently at least, exterior to his own person. The once before cited phenomenon, that usually when there is an excitement either of the nerve-cells or of the nerves leading to them, the sensation is felt to have an external cause, is easily productive of similar errors, for internal pressure may give one the idea of external forces, and thus these two phenomena combined, may impart to us an absolutely false impression of our position in the universe. Touching the optic nerve produces in us a sense of light, the auditory nerve a sense of sound, and the olfactory nerve a sense of smell; and yet there may be no light, no sound, no smell. The touch itself is the only real

Habit or custom is monomania pleasant to us. It is the result of such deep impressions (*i.e.* such radical physical constitutional alterations) on our brain, that we with difficulty grasp the true conditions. Thus,

> "custom with most men prevails more than truth; according to the notions and preconceptions which it hath formed in our minds, we shape the discourse of reason itself." [1]

We can be so in the habit of praying to a god, that we involuntarily call on him and call in his aid long after we ought to know that there is no god to call on. Most people, and therefore atheists also, when they have arrived at that age which is not far short of the span of three score and ten years which experience has taught them is allotted man to travail on this earth, feel a not unnatural proclivity towards retrospection. Bit by bit they mentally retrace their steps to the days of their childhood—in very many cases, on account of later hard buffeting with the world, the happiest part of their lives—and they recall the time when dear parents and dear friends taught them the sublime love of a supreme God. Is it then a wonder that they now mentally combine the ideas of a happy childhood with the beliefs inculcated in that childhood, and that this happy past is again so vividly and powerfully brought before them, that they inexplicably feel impelled to cry out, 'Oh, how happy were my childhood's days, may my going, oh God, may my going be as happy, as peaceful as my coming'? And this prayer, involuntary though it be, but tends to impress them the more with the early but latterly discarded beliefs, and they who in the hour of

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[1] Hakewill's "Apology," *i.* 1, § 6.

highest intellectual capacity would have scorned the very idea, are now anxious, aye humbly plead, with solemn ritual and religious observance, to be buried with and in the faith of their forefathers.

Our study of consciousness and voluntariness is retarded by the reflex action of our mental system (*vide* pp. 15-16). Thus, during the time which lapses between an excitation and an action, another stimulation which may have taken place would have been lost to us. To quote myself: 'An action *appearing* or *seemingly* alone may be followed quickly by another. Were it known, *i.e.* conceived by the brain that the first-named action was not independent but dependent, it might have obtained quite another impression of the proceeding as a whole.'

Words, in connection with memory, awake the imagination (*vide* p. 17). Our imagination is further influenced by unconscious thought, produced in part by the past and in part by our inherited memory and in dreams. Thoughts and impressions being indiscriminately let loose, imagination becomes again—to use my own words—a 'great incubator of error and discrepancy, for in the first instance, it is not always easy to discern the imagined from the real, and secondly, so many different thoughts of different experiences are often to such an extent simultaneously and indiscriminatingly let loose (the 'registrations' of impressions being packed so near each other), that the imagination no longer depicts an integrity, but mixes up so and so many conceptions together, and one believes he sees things or deems himself conscious of feelings (sensations) which never, or did not momentarily, take place.'

Our intelligence and therefore our powers of observation, discernment and discrimination are dependent in the first instance on the length of our experience, the number of opportunities we have had of increasing it, and the amount of use to which the nerves and their end organs—the organs of sense—have been put and the degree to which these have been exercised; and in the second, on our state of health, the fineness, delicacy, and sensitiveness, and sensibility, the accuracy, and constituency of the nervous system (*vide* p. 23, as also p. 48, ¶ 1). A capital example of the value of long and great experience as a sense-sharpener is to be seen in the increased discrimination of colours and shades by children. Yet more pronounced is the enhanced capacity to discern minute variations in taste as evinced by the professional gauger or judger of wines who can pick out any choice vintage, and the tea-taster any special tea, a

capability denied to the less practised. That health plays a not unimportant rôle, is demonstrated in that certain corporeal ailments are the cause of myopy. A simple case of indigestion is sufficient to cause blurred sight or a change of colour in the environment and thus to give us another impression thereof. The dyspeptic is, as I have already said, moreover querulous and is therefore less observant and often mistakes causes. He suffers too, very often with pseudogeusia. Sensibility varies a great deal with the nature of our bodies. Thus therefore, the sense of touch in the rough, horny, proverbially thick-skinned finger of the peasant is far inferior to that of a member *de la haute volée*, and an elephant is far less sensitive to touch than a peasant. Much depends on the temperature, pressure, humidity, and other obtaining physical and chemical conditions. That this is so, is seen by the effect of climate on character. A blue environment will act as an anæsthetic, a red one as an irritant, and so on. Then again, the medium alters our perception. *E.g.* air is transparent in thin sheets, but the stars are set in blue—the stratum being thicker. Diminution of pressure on our eyes seems to enhance its visual capacity. Thus, the Paris eye specialist, Dr. Robert Daulnoy,[1] with experiments from a balloon which were made at an altitude of 6,000 feet, observed that the organs of vision underwent certain changes. The pupils distended, the sensibility of the optic nerve was considerably increased, and there was a very marked increase of the acuteness of vision. Beer tastes differently, according to the vessel from which it is drunk (*vide* p. 30). 'One forms a conception of a thing according to its size, shape, and brilliance,' but 'such conception of size and shape may of course be false, *i.e.* be an illusion' (*vide* p. 36). Metallic lustre and size often lead to a misjudgment of weight. Of two equal weights, the larger appears the lighter, because a body decreases in weight with an increase in its volume. This may cause us to undertake wrong movements by causing us to wrongly prepare our muscles. The state of the nerves is dependent too, to a great extent on the quantity and quality of food, of drugs, bacteria, and so on, and our age. A hungry man does not stop to note fine differentiations in taste. A person accustomed to condiments, finds their absence a cause of insipidity in all he eats. The drug mescal not only produces a sense of wondrous colour-combination and kaleidoscopic effects, but makes the partaker more sensitive to light and colour.

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[1] *Vide* the "Daily Mail" for May 21st, 1906.

Coca limits our sense of taste. A several-days' diet of lemon juice perceptively enhances our sense of touch (*vide* p. 323). Our age has much to do with our impressions. The intelligence, after a certain age, generally diminishes, judgment is not so sharp, and the brain ossifies. Eyes lose their focussing capacity. At about ten years of age, the power of accommodation of the eye has reached its natural climax, yet adults such as engineers, architects, surveyors, astronomers, and the like, all, up to a given age can, by daily practice, continuously attain higher powers of gauging heights and distances; but is this limit—usually 38-45 years—overstepped, the adaptability of the pupil readily to adjust itself to varying dimensions gradually lessens.

What a poor sense of locality is possessed by the majority was a favourite subject of experiment by the late Stuart Cumberland. After blindfolding the subject, he would stand in some corner of the room and shake together between his palms a number of silver coins, and in nearly each instance there was a failure to fix the place whence the clinking sounds issued.

An important cause of error is often the confounding in one's own mind of the abstraction with the conception of that abstraction (*vide* p. 29). One has, for instance, to guard against confusing a probableness or a probability with the conception of a probableness or the conception of a probability or a possibleness or a possibility with the conception of these. One must be very careful not to mix up the veritable reality with its conception; for we dare not forget, that although it is conceived, it is conception only. Moreover, there is a great tendency to lose sight of the distinction between conception and idea (*vide* pp. 35, 36), and ideas, though not entirely, are mostly based on illusions. That only which is conceived should be for us the veritable reality, although of course one may form ideas as to its nature.

And now another point calls for attention. A great part—I might with probable veracity say the greatest part—of our so-styled knowledge is based on inductive evidence, and the most of this again on the evidence of witnesses. How little these latter are to be relied on can be judged from an example cited by me (*vide* p. 62) of the three lookers-on at a football match, each of which, according to his place of observation, received a different impression of one and the same event of the game. A still more remarkable illustration is that of the mountain spirit. In Germany, the apparition is known as the Brockengeist or ghost of the Brocken. The curious pheno-

menon is however also seen from balloon or the sea. The cause is usually the same: A setting sun with horizontal rays and a bank of clouds in close proximity, casting in this way a huge shadow of the person, surrounded by a rainbow-shaped aureole of rays. The enormous size of the shadow is an optical illusion originating in a false judgment as to its distance. In a special case, I remember reading in the "Prometheus," I forget exactly in which year, that this illusion had been seen by Prof. Fenneman of the Colorado University at Bulder and three companions on the summit of the Green Mountain in Colorado. The ring of the aureola had a diameter of about 9° and its colours were in the reverse order to a rainbow, *i.e.* the violet within and the red outside, but my reason for here mentioning all this is the extraordinary fact, that each of the four men ceased to see his friend's shadows as soon as he moved away only just a few steps from them. As with visual discrepancies, so is it with that known generally. Accordingly as the information on any one subject is obtained, and according to the nature and character of the individual informant, so varies the impression of him who gathers the information of the subject. Even if two persons obtain fairly similar results, their capacity to communicate to another what they have learnt may be so different in degree and quality, that two quite distinct ideas are implanted. We should never rely on the deductions of others. As no two things can occupy the same space, and as no two actions can take place within the same space at the same time, so cannot two persons occupying two spaces ever have absolutely the same experiences. Experiments made in 1903-4 in Germany and this year (1906) by Prof. Claparede of the Geneva University go far to show, that even the individual witness cannot, after a few days, remember what he has seen or heard or actually correctly to cognise any unexpected actions which may suddenly and rapidly take place. In the German experiments, where a preconcerted quarrel took place between two of the audience, not a single person present, immediately after the act, was able to give an accurate account of what had actually taken place. In Geneva, a masked man, enveloped in a white shroud, made signs and disappeared. After four days, out of twenty-four students, only four chose the right mask from among ten others from which it materially differed both in colour and size, whilst eight others were unable to make any decision at all, and twelve picked out wrong ones. Can any one hereafter put implicit and absolute faith in the writings of scribes, recorders, disciples, or historians?

We have found that all and each thing is in a state of flux. Nothing is absolutely in the same condition that it was a moment previously, although the change may be so minute as not to fix our attention. The result of an experiment may be impossible of repetition after a single second, although to the eye everything is essentially as it was. When we make our deductions, they are from observed facts, but the while we are forming our conclusions, new events are constantly taking place, and we are therefore always behindhand in our results. But, generally speaking, these variations are small in degree and we can, as a rule, form fairly true ideas and conceptions, although not absolutely so. It has to be borne in mind that varying causes can never produce the same, but only similar results (*vide* p. 29, last ¶); and that one cause may have more than one effect. Also not to be forgotten is the fact that experiment itself is not absolutely trustworthy (*vide* p. 30). Remember too, that 'an image is a true conception only to those who know it to be an image, for conceptions are based on true knowledge, and the mind's image of the universe is, alas! based more on ideas than on conceptions' (*vide* p. 37).

Another thing not to be lost sight of is that the study of the separate force-forms is in this wise misleading, that one can never know everything about any one of them (*vide* p. 67) and that therefore no true deductions can ever be formed of the relationship which the one bears to the others.

When a result is seen, we, by virtue of what experience has taught us, make the deduction that a certain cause must have produced that effect. Now it has been shown, that many causes can produce a similar effect; but quite apart herefrom, there are instances where a given cause, which in the usual course of things would produce a specific effect, anomalously yields a result just exactly the contrary to that which was expected of it. It is moreover a fact, that when, for instance, the heart nerve is stimulated, the heart ceases to beat. Of these nerves, known as retardatory,[1] there are several in the human body. In a retardatory nerve, there is nothing to prevent an excitement taking place. There is only a reversed current. The proof hereof is that if respiration be inhibited or held in, it is more difficult than before to get into the normal working order. An expenditure of much more energy is required to set breathing again going, than to stop it. Cannot this state of things

[1] *Vide* Rosenthal, p. 281.

be likened to the magnetising of a steel bar by passing a current through it? In any case, it is highly probable that many people have nerves which, when they receive stimulation from another person at a given amount or/and pressure, act similarly to a retardatory nerve. This would account for a man springing up when hypnotised, to sit down (*vide* p. 103). When we 'will' a thing, *i.e.* become conscious of a tendency in a given direction, we naturally await from experience a given result. But this result may turn out entirely different to what was anticipated. When one person 'wills' another to do anything and gets something else, one is conscious of the tendency in one's own body being met by a retardatory or contrary current in that second person. It is comparable to magnetising a steel rod inserted into a telegraphic system, the earth current being represented by the air current. In like manner, the motive of a person is not always accognisable by its result, for the result may be bad and the motive good, or *vice versâ*.

As there is an infinity of causes, we can never know all of them. But there is in my mind little doubt but that thoughts telepathed by one individual may fall on the involuntary thoughts of another, thus producing quite remarkable freaks of imagination, and causing much misjudgment and error. In this way too, it is probable that the thoughts of a person dying may call up his or her image in relatives or those in whom he takes a special interest, though they may be ever so far away. Mr. A. G. L'Estrange, in a letter to the "Daily Mail" (August 18th, 1906) rightly calls attention to the fact that the information must be conveyed psychologically, for it often takes place during dreams. The image of the person dying "is thrown on the retina of the eye not from an external object, but internally from the brain."

I have hitherto pursued the policy of every now and then ascending an eminence whence the mental gaze could more uninterruptedly wander over a broader tract than were on the level at all possible. By the maintenance of this principle, the task that we have set ourselves will be not inconsiderably simplified. It were well, instead of indiscriminately hacking our way through to nobody knows where, to get a general all-comprehensive view of the position, so as to come to a decision as to the easiest and least bewildering modus of forging our way ahead.

The highest and most formidable barrier to the truth lies, I am glad to say, at the *ultima Thule* of our vision, for it is insuperable. Spacious though our view be, the circling horizon is reflective, and

what it reflects is ourselves. And as we can never quite obliterate ourselves, so will this reflection always mar the aspect which otherwise were attainable.

All we know and all we understand has reached us *viâ* the senses. Each sense is difference by reason of the difference of our sense-organs, but our nerves are all alike. Hence it is impossible to deduce what is actually going on around or within us. The lenses or senses through which we scrutinise the universe are not in all people equally developed, and it is to me not improbable that insects, animals, and even other persons may have senses which I have not. Thus I have an idea that a telepathed message may be received and recorded only by those possessing an organ especially adapted or adaptable to this. But there are certain senses which, probably on account of their generality, have now come to be looked upon as indispensable to any fully equipped being, and those not possessing all these are said to be wanting or deficient in such and such a sense. These are hearing, seeing, smelling, tasting and feeling. This last, 'feeling,' is a very ambiguous expression, used with reference to touch, a sense of contact in general (*vide* p. 23). But just as the most primitive animals possess solely undifferentiated sense-cells with but one single undefined sensation, that of touch, which gradually evolved as above enumerated, so has Dr. Henry Head now conclusively shown that the sense of contact has yet further developed and provided us with three special organs for the reception of touch (contact), temperature and position, and pain (*vide* p. 90). To these may be added muscular sense (*vide* p. 23), the static sense (*vide* p. 54),[1] and the sense which has been called by me the sense of desideration (*vide* p. 33). Summing up, we have therefore the senses of hearing, seeing, smelling, tasting, touch (contact), temperature and position, pain, desideration, the muscular and the static[2] senses, or ten in all. One reason why I do not expect a further differentiation of the senses, is that intelligence is apparently on the wane and therefore more acute powers of observation are not to be awaited.

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[1] John Lubbock finds the organ of this sense for the maintenance of the equilibrium of the body solely in three semi-circular canals of the labyrinth of the ear at right angles to each other which

"are affected by the position of the head."

("The Senses of Insects," p. 79.)

"When they are injured, the movements frequently become disorderly."

(*Ibid.*, p. 82.)

[2] A loss of this sense entails the condition of Static Ataxia, which may be caused, among other thing, by Tabes.

Are various force-forms acting on the various organs, or is there only one single force-form which, according to the finely gradationed amount, degree, and amplitude with which as excitant it is brought to bear upon us, is productive of the nicest differentiations of mental impressions? Although our bodies, and for that matter the existence of matter itself, appear to speak against this supposition, yet the definite answer must ever remain unknown. Understanding cannot help us. Reason may.

Arrived at this point, there is a not unimportant bifurcation, but not for a breathing-time do I pause to reconnoitre.

All that is actually understood is that we exist, are real (*vide p.* 39), *that we are forced to conceive that our conceptions are real* (*vide p.* 35), *and that we are forced to conceive of force influencing us, influencing our conceptions—i.e. that we and force exterior to us exist* (*vide p.* 24) *and that we conceive, form ideas, and act as we must.* We and the force exterior to us are Kant's and my own "Ding an sich," 'the thing itself.'[1] Molecules, atoms, and electrons are abstractions only, as realities they are illusions only, and the trend of this work has been to demolish the atomic theory (*vide* pp. 71, 72, etc.). Haeckel and others have supported the theory of the conservation of matter; but of a verity, any theory of the comminution of matter to infinity is illusory, the ἄτομον, the indivisible is an illusion, there is a natural limit thereto—dissolution—when matter dematerialises. Was Shakespeare a prophet when he wrote,

> "The cloud-capp'd towers, the gorgeous palaces,
> The solemn temples, the great globe itself,
> Yea, all which it inherit, shall dissolve"?[2]

I cannot conceive, as do Lord Kelvin, Prof. Haeckel and others, of an infinite continuous matter called an ether (*vide* pp. 78, 87, etc.), and the law of the conservation of matter is to me an impossibility. Force alone is, is the 'thing itself.'

We mortals, for the sake of comparison, call our impressions the subjects and the causes of these impressions the objects: that is to say, that which the 'thing itself' produces is the subject, whereas the 'thing itself' is the object.

Reason can add, that we and all matter belong to, are part of the force which encircles us (*vide* pp. 72-80), but at present even reason has not sought to solve the problem as to whether there is one force-form—or many force-forms. Axiomatic it is therefore, that I prefer

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[1] This is the answer to the question of p. 26.

[2] Tempest, iv. 1.

to judge by what I conceive, by what I can understand (*vide* pp. 35, 36), although I may, if occasion require, take a peep now and then at the ideas of reason.

* * *

From the standpoint which we have been forced to take up with regard to the universe, we can see that a universe exists, and that this universe is one of force (*vide* def. p. 72), the absolute reality (*vide* def. p. 62).

* * *

The force is infinite (*vide* pp. 54, 55), *i.e.* it has no beginning, no end, no boundary, nor periphery. The infinite conservation of energy is a fact (*vide* p. 58).

My conception of infinity has a derivative existence, is *à posteriori*. That one actually does arrive at a conception of infinity as I have hermeneutically shown, by experiencing an endlessness on each side of and then through ourselves successively (*vide* p. 55), is evinced by another conception of ours—a mathematical one, and therefore also *à posteriori*—that of the asymtode of a curve which is every tangent thereof which does not completely lie in infinity and the point of contact of which is infinitely distant. One can even conceive crooked-lined asymtodes.[1] Of a similar derivation is the hyperbola and so on. The conception of infinity, founded on an ever-increasing distance from ourselves, is even given expression to by the poet Goethe in the words:

"Willst Du in's Unendliche schreiten,
Geh' nur in's Endliche nach allen Seiten."

Eng: "Wouldst thou step into the infinite,
Go thou to all sides in the finite."

* * *

This infinite force occupies space (*vide* pp. 47, 49, 50); which space, as a real abstraction (*vide* p. 63), is boundless or infinite (*vide* p. 55). The conception of space is a conception *à posteriori*.

Although space is infinite, it is occupied by infinite force, and therefore there is no such thing as an empty space. Peters was therefore labouring under a hallucination (*vide* p. 51) and of those ancients an engkomion should be sung, who accognised that a void was an impossibility, an illusion—the Eleatics, Empedocles, and the venerable Anaxagoras. Herein did these do good service by definitely denying the to me impossible Parmenidean doctrine of the One Being (a physical plenum) being not only 'equal in all directions,'

[1] *Vide* W. W. Johnson's "Curve-tracing in Cartesian Co-ordinates"; New York, 1884

but 'equally contained within limits': or in other words, the conception of a being existing somewhere, with empty space surrounding it. Schopenhauer conceived that all realities, except the absolute reality of a will and all abstractions were conceptions only (*vide* p. 77), whereas I cannot conceive of a will-force at all—that being believed to be will turning out to be nought but a special consciousness (*vide* bk. ii., chap. iii.).

* * *

As force is infinite, and as we exist, so are we a mode of force (*vide* p. 24, ¶ 1). But we are not the only force, and we are limited by our shape (*vide* pp. 48, 49). The conception which I am forced to possess of the space taken up by our shape and by all shapes, is the Megarian or tri-dimensional space and any other space were to me impossible (*vide* p. 76).

* * *

Being limited, *i.e.* being finite, but a part of the entire, we can never understand the remainder although we may reason about it. And each individual can only reason about the whole according to his or her aspect thereof, and each person's point of view is different, the veritable reality (*vide* p. 62). I can therefore be positive of only *my* conceptions, whilst those of others are for me either possible, probable, improbable, or impossible.

I personally, cannot conceive of the existence of one sole force-form. All that my intellect permits me of understanding is that there is one infinite force assuming many forms.

Here the way divaricates.

The one path would lead us to Nietzsche's conception (*vide* p. 83), that there are a fixed number of perrotatory forms and that therefore after the limit defined by the greatest possible number of combinations and permutations, all that has been, will be again. Herein I cannot acquiesce (*vide* p. 65). My conception, aided by my feelings (representative of the tendency-current in which I momentarily find myself), will burst asunder this manacle of fate. Where were that infinity, I so love to sense?[1] What would become of that beneficial feeling that I can strive for higher and better things? If I lie or thieve, must I, in a new life, live to lie and to thieve again? Must I suffer all the anguish, all the pain of this life not once, not twice,

[1] Of course one might form an idea that a limited number of forces could compel me to conceive anything, even infinity itself, but the fact is that I do not, cannot conceive of this state of being. *Vide* also footnote [2], p. 62, of this work. I, for my person, cannot conceive nor even form an idea that it were possible for a limited number of circularly arranged forces to start and infinitely to keep themselves going to infinity. And it is to me most improbable, if not impossible, to conceive of a limited force coming for say a few million years into existence, again to disappear, to non-exist.

but in a given series for ever and for ever? Nietche evidently thought so, and went mad. Do not think as he.

The other path guides us to the conception of a force assuming in infinity an infinite number of forms, and thus a force-form will never move in combination with another force-form exactly as it has moved. The scope of this work, as outlined by me, will not permit of a further dilation of this subject, but I feel pain and grief in reluctantly contemplating the first route; and we have seen that that which gives pain must be against the main trend or tendency (*vide* the last chapter) and be wrong. I tread with a buoyant step into the realms of the unknown, the ever changing.

But here, precision is necessary. Although the assumable force-forms and combinations are infinite, the force-combinations which are taken up as matter are numerically finite, and after coming into existence, again dematerialise.[1] It appears that dematerialisation is attained *viâ* radiation (*vide* pp. 80, 81), this again being the result of an electrical condition.

A universe of which I can very well form an idea[2] is exoscopically adumbrated by me on p. 84. The universe is 'thought of as an infinity of boundless planes, capable of infinite shifting, lying in innumerable directions, such planes being made up of countless lines of force. Each force having its own influence and being in juxta-position to others, motion is going on infinitely in all planes, the parts of which are elastic to infinity, *i.e.* being capable of being drawn out of place by one force, but never being quite out of control of another.' I see many reasons, which shall on some future occasion be discussed, why just in such a system as that described, the nebula hypothesis is the most likely to turn out the true one.[3] Be this as it may, in some wise or other, the first bit of matter, probably in a state of diffusion in which the parts were much finer than electrons, and but very slightly differentiated from the medium of their interspatia, came to be. There is, it is true, in this hypothetical system an unbroken continuity of force, and no ether, and therefore it is contradictorily opposed both to Osborne Reynolds'

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[1] Prof. Rutherford, in the "Philosophical Magazine" for July, 1905, most ingeniously points out why disintegration is not always detectable. *Vide* also an article 'The Alpha Stream,' being an article on the above by Alfred W. Porter, B.Sc., in "Knowledge" for Aug., 1905.

[2] Not a conception. I used the term 'conception' on p. 84 solely in the popular sense.

[3] An interesting article, explanatory in part of the spiral form of the planetoidal orbits is to be found in W. J. Knight, LL.D.'s, article, 'The Disintegration of Saturn's Ring System,' in "Knowledge" for Jan., 1906.

and to John Fraser's[1] theories as they stand, which presuppose an ether in which matter is represented by its interspatia or gaps.[2] But yet Fraser's crude idea may not be so far wrong after all, if his notions be somewhat amended. It is only requisite to imagine that the original exceedingly fine parts of matter were formed not as

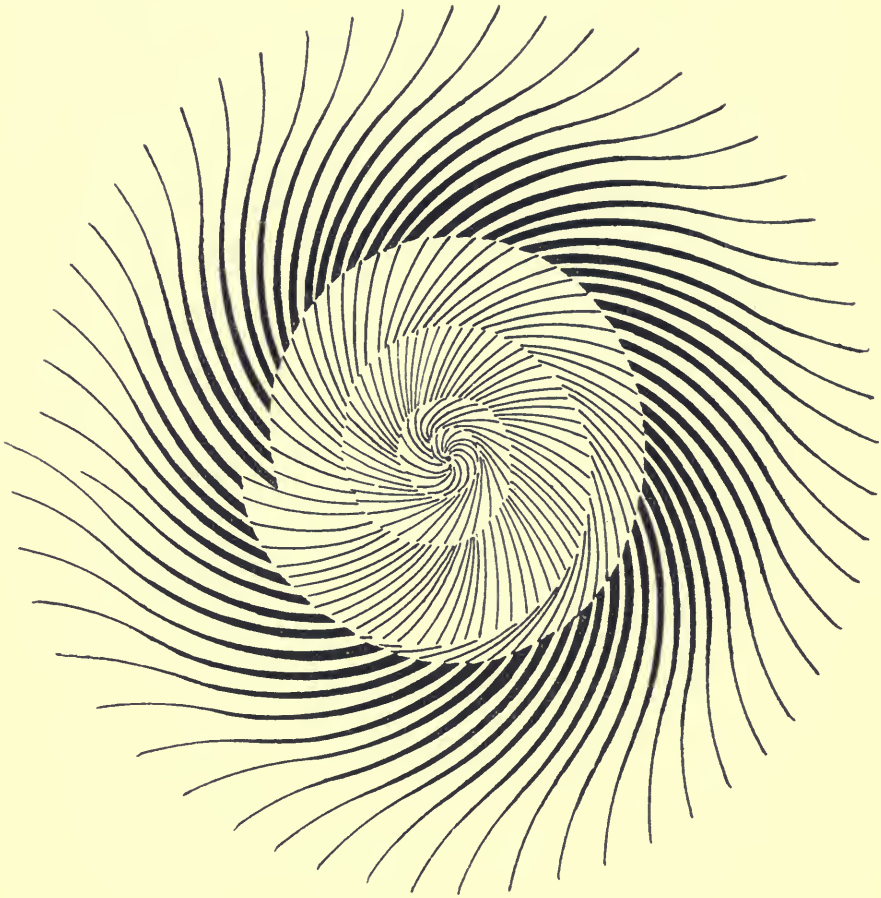

Fig. 15.

gaps in an ether, but as spheroidules,[3] formed by motion in a space of such a shape (*vide* Fig. 15).

> "The figure of the atoms of all visible fluids, quà fluids, seemeth to be globular,"

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[1] *Vide* "Suggestions towards a Theory of Electricity based on the Bible Atom," by John Fraser, being reproduced from the "Proceedings of the Royal Society of Edinburgh," 1905.

[2] It is interesting to recall that Lord Kelvin's ether is a perfect continuous fluid.

[3] A self-coined diminutive of spheroid.

says Grew.[1] The figure on page 357, which was sketched by me, has been kindly drawn by Mr. J. Bartlett, M.S.A.,[2] who made the pertinent remark that its conception resembled much the puddler's stirring of bloom in the treatment of cast to wrought iron. These spheroidules are only hollow (*vide* p. 182) in the sense that they have an action of a given kind limited to the circumference alone, but they would of course contain forces acting in other modes and wise or else there were empty space, of which no conception can be formed. The interior forces are in direct connection with those exterior to the spheroidule, for this latter cannot be perfectly closed, because every force acting on every other force, no force or set of forces can have its full effect. No line is perfectly round nor perfectly straight (*vide* p. 57, ¶ 1), every force or body (force group) being bounden to describe its trajectory curve:

> "There is neither a straight line nor an exact superficies in all nature,"[3]

and Jeremy Taylor somewhat differently, but very prettily, expresses this with his remark that

> "the first reflections of a crooked tree are not to straightness, but to a contrary incurvation."[4]

There is, to my mind, nothing in the way of the spheroidules coming into existence electrically, and it would not necessitate any very great alteration in Fraser's theory. It is just possible that I may at some time convenient to myself, formulate a theory of my own.[5]

Once these little whirlabouts put in an appearance, they were in no hurry to evacuate the position they had so arduously gained. They possessed a great power of adapting themselves to their surroundings, a quality which has been hereditarily handed down to the Germans, but seems within a few centuries to have been gradually lost in the environment of Britain. Climate has probably much to do with this phenomenon. It is this trait of adaptability which will, in the end, give the Germans an ascendency over the English and help the former to wrest all laurels from the latter. They are ousting them in trade and they will oust them on the seas. It is this characteristic which made the spheroidule come to stay. It (the spheroidule) not only made a cordial and attractive

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[1] N. Grew, "Cosmologia Sacra," i. 2.

[2] Lecturer at King's College, London.

[3] Goldsmith.

[4] *Vide* his works (ed. 1835), ii. 252.

[5] Fig. 15 is sufficiently demonstrative of my meaning, but absolutely wanting in scientific value to illustrate mathematically in detail my especial theory.

coalition with all its neighbours, but had the further charming attribute of being able to continuously maintain the firm bond it had formed with them. On they came, marshalled by Eos from widely distant parts, in a mighty centripetal rush to join hands the one with the other. And then came that supreme moment when occurred that grand osculation of the tiny spheres which thenceforward was to hallow all their undertakings. Burning kisses, kisses, kisses: the orbs verily glowed with delight. I cannot feel like Irving that

> "there is something exceedingly delusive in thus looking back through the long vista of departed years, and catching a glimpse of the fairy realms of antiquity,"[1]

for the light they kindled, travelling down through millions if not billions of years (*vide* p. 207), is the light by which I see, which guides me to-day and likewise the light by which I exist. Territories were acquired or wrung from Chaos and her daughter Nox, and they planned immense organisations. Suns, stupendous in magnitude, globose of form, and moons and

> "the great stars that globed themselves in heaven"[2]

and our world came into being. Prodigious though the task, their labour was one of love, undertaken to the accompaniment of symphonious Orphean strains; and as the harmonious music of the spheres reverberated through the realms of space, so great was the ardour and the fervency of their embrace, that they stirred the ponderous mass to life (*vide* p. 260). A heat, in intensity transcending the imaginable, a slight abatement thereof, great gusts of strangely luminous præ-material existence, a further scarcely perceptible relaxation of temperature, and weirdly gleaming, wondrously moving, perpetually form-changing, grotesque cyanogenous shapes of incomputable magnitude whirling cyclone-like past in the glowing mass,—a scene of unintelligent order, fearful to the sight and in immensity, indepictable even by a Dante. A slackening of celerity, a decrease in heat and strain, and the tempestuous haste gives place to a beauteous quietude. Substance is forming; there is a coming of water surpassing in its incomparable pristine translucency aught that is known to man. 'Twas then that gentle Juno gave to Mars and to Bellona birth. What a deafening hissing sound, as waters join in fierce combat with the bellicose flames! Cirrous clouds of steam, pensile o'er the hostile elements,

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[1] "Knickerbocker," p. 138.

[2] *Vide* Tennyson's "Enoch Arden."

enshroud the tactics of furious battling antagonists. Wondrous pictorial effects, the perfect transparency of the environment giving place to fitful alternations of light and shade.

The white veil lifts, discovering the belligerents, both losers in the fray. The aqueous element has dulled the gorgeous splendour of its fiery foe and the resulting leviathans, no longer one colossal piece of living luminosity, show marcescent ardour, only when exceptionally hard pressed, belching tongues of flame from their hoarse throats and widely distended quivering nostrils, fiercely emitting shafts of fire from their eyes or scintillating their silicious[1] scaly coats of mail —and then decumbent expire and are no more heard of save as they are, like the phœnix (*vide* p. 260) recorded in the annals of heathen mythology. On the other hand, the waters that onwards dauntless dash, wildly tossing their shaggy manes of crystal clearness, are now, panting still, weary of the fight, and dim glaucous shade is substituted for extreme pellucidness. In the water appear indistinct shadows. There is a peculiar turbidity which becomes more and more dense. Death and birth are near of kin. The earth is forming and taking shape. Earth with water join in embrace and give to the primordial somacule birth. Then other protoplasmic existences appear on the scene, and love is the order of the day. Births and deaths occur in quick succession, and their decomposing bodies, mixing with other earths, build the foundation of future continents. These reach the surface, coming into contact with a new-formed atmosphere, and argillaceous mass is formed whereon life, once started in the aqueous depths, continues its career of wondrous romance. After vicissitudes innumerable, and like Jupiter assuming many forms, it, to perpetuate itself, takes the shape of an ape, Pithecanthropus alalus[2] by name and,—now I am laughing at you, dear readers, long and heartily: partly at your startled visages and shocked countenances and partly from sheer hilarity, for had it not been for this dear ancestor, neither you nor I would ever have been in existence. Of him Gay gaily wrote:—

> "A monkey, to reform the times,
> Resolv'd to visit foreign climes."

In these new climes, our beloved progenitor, in common with most reformers, could not leave any lasting impression. On the contrary, he and his successors had to materially change their mode of life and lost nearly all their hirsutical adornment into the bargain.

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[1] *Vide* my references to Martin.

[2] *Vide* p. 318.

What was left on their faces, still held the dirt, so they shaved it well nigh all off save the moustache, and some have gone to the extreme of removing even that. Then, too, they were originally of a black stock, for the natural tendency of living bodies appears at that time to have been nigrescent. Now, however, there seems to be a reversion to clearness and transparency, for comparatively recent generations are flesh-coloured or a creamy yellowish white.

This evolution of white is not wholly due to temperature, for in the "Proceedings" of the London Zoological Society for May, 1906,[1] is a description of the guerezas monkeys which, starting as quite black, have now in gradual transition become furnished on the face, flanks and hind quarters with long fringes of pure white hair, which may in part be due to a gradual change in the food to be found in their neighbourhood, and in part to the white lichens on the boughs on which the monkeys climb and sleep.

We are now in a position to answer the question which I have chosen as a title to this work, "What are we?"

We are a marvellous enmeshment of the force-forms of one universal force, *i.e.* ourselves a mode of force. We may not be at all what we conceive ourselves to be, yet we are, and that of which we are a part is; or as the heading of this chapter has it, '*Id est—nos sumus.*'

* * *

Does force only exist as I am thinking so, am I and are you only there now as I think we are; or shall we be there after the thought as to our existence is not—was force there prior to our existence?

There are certain very important individuals, but for whose existence dead mass were not present, nor the living born (*vide* p. 53), who unnoticed have yet been concerned in the entire concatenation of events which I have just described. Unostentatiously, one might almost say surreptitiously, they have mixed in every incident both great and small which has taken place. Nothing can be done without them, everywhere they leave an impression of their appearance, yet unheard and unseen they come, unheard they go, nobody taking the least notice of them save in the last millenaries, the astronomers, astrologers, horologists, and historians. They are old Chronos and his young darlings the Horæ; and being an open secret, it is no indiscretion to say that the latter are the daughters of Jupiter and Themis.

[1] *Vide* also "Knowledge" for June, 1906.

Here the question crops up among the curious as to how it is that this giddy party always succeed in escaping observation. An answer has been found. They are abstractions only, real abstractions if you will, but nevertheless abstractions. They have, apart from the universe, no independent existence. They may even have no real existence as abstractions or attributes; but we, at all events, cannot conceive a universe without them, they are to us real, and as a matter of fact they are only conceived after we have conceived somewhat of the universe. Their conception is therefore, as is that of shape, geometry, and mathematics, *à posteriori* and not πρότερον φύσει, or *à priori* (*vide* p. 53). We are forced to conceive that force was and will be, as well as is. We were from our birth and will be till we die.

To sum up: All is force, force from and to infinity. Matter entered our universe centripetally, it makes its exit *viâ* radiation (*vide* pp. 80, 81), which is an electrical phenomenon.

The force, of which we are a part, is real and absolute. That to which the senses respond is real to the individual possessing them. There may be more real, there may be less. That which is sensed is a veritable reality. My standpoint therefore stands out in sharpest contrast to the ancient Indian conceptions as represented at their grandest in the philosophy of the Upanishads, and which have been reflected in modern times by Schopenhauer and more recently still by Dr. Deussen,[1] in all of which there is a negation of 'the thing itself,' all being 'appearance' only. Phenomena are realities which have no condition apart from a condition in which I view them. The idea of the existence of phenomena is an hallucination, dependent on my having observed various phases, conceived of the veritable reality otherwise, and then come to the conclusion that an absolute phase must exist other than I conceive it. In other words, there is an absolute reality, but no absolute phase of that reality any different to what I conceive it; although there may be other aspects of it. This is stating the case even yet more precisely than on page 280 I was able to do.

* *

Force is not only infinite or omnipresent, it is eternal.

* * *

There is omnimutability or omnitransmutability, *i.e.* a changing to an infinity of forms; there is sempermutability or sempertransitivity, or an eternal change of form, and no form assumed can ever be

[1] "Allgemeine Geschichte der Philosophie," vol. i., part 2, by Dr. P. Deussen; pub. F. A. Brockhaus, Leipzig.

exactly reassumed; although the assumed form may be so similar that man is incompetent to perceive the difference.

Of the nature of some of these slow transformations, we are gradually getting a slight idea through radiometrical research work. F. Soddy, M.A., has herein done us great service by experimentally demonstrating that uranium, radium, and helium are successive transmutations (*vide* pp. 181-183) of one and the same substance.[1] The comparatively recently discovered Ceylon mineral thorianite, as lately analysed by Blake and Prof. Dunstan at the Imperial Institute, London, contains not only 70-80 per cent. of thorium dioxide, but also 10-12 per cent. of uranium oxide and rare earths, as well as oxides of lead and iron, as also 0·39 per cent. of helium. When one remembers Prof. Rutherford's connection of lead and radium (*vide* p. 182), it is not expecting too much, if we anticipate the demonstration in the near future, of iron, thorium, lead, uranium, radium, and helium being commutable states of existence to which may probably also be classed zinc, gallium, tin, and silver. Were the alchemists of medieval days after all on the right track? Will our progeny of many generations hence be able to change copper into gold, as was perhaps the dream of those ancients who invented the story of the Phrygian king Midas who was cursed with the possession of the attribute of turning everything he touched, even to his food, into that precious metal? Transmutation to gold was the cause of this king nearly starving; greed brought its own punishment, for the action to obtain all, was met with the equal reaction that he could obtain nothing. Let this be a warning to us.

> "The elements are not unchanging and eternal . . . and existing knowledge at the present time points to the view that gold is scarce and lead is common because gold is changing more rapidly than lead . . . inevitably in the lapse of ages these changes must make themselves felt, the more stable accumulating in quantity at the expense of the less stable.[2]
>
> "We now know from recent experiments that radium is itself a product of uranium, and is in fact a transition-form in the uranium disintegration series, with a period of average life between one thousand and two thousand years. The uranium is a million times less active than radium because it is changing a million times less rapidly, and will therefore last a million times as long. But, as a

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[1] *Vide* "Knowledge" for September, 1905, as also the art. 'The Internal Energy of Elements,' in the "Journal of the Inst. of Elect. Engineers," vol. xxxvii., No. 179 (August, 1906), pp. 140-147; and p. 59 of this work.

[2] The above Journal of the Institute, p. 145.

consequence, for every gram of radium found in a mineral there must exist at least a ton of uranium. One thousand-millionth part, or one milligram per ton, of the uranium undergoes change yearly, producing nearly one milligram of radium (probably together with helium)."[1]

"It is probable that the elements as a class all possess great internal energy, and that their characteristics of stability and permanence, and the failure of all attempts to change them by artificial means, is due to the existence of this internal energy. The forces at our disposal, compared to those which are exhibited when an atom suffers change, are of a different and lower order of magnitude, and it is not to be expected therefore that transmutation will become possible until we can control more powerful agencies than are at present available.

"Let us consider in the light of present knowledge the problem of transmutation and see what the attempt of the alchemist involved. To build up an ounce of a heavy element like gold from a lighter element like silver would require in all probability the expenditure of the energy of some hundreds of tons of coal, so that the ounce of gold would be dearly bought. On the other hand, if it were possible artificially to disintegrate a heavy atom like lead and produce gold from it, so great an amount of energy would be evolved that the gold in comparison would be of little account. The energy would be far more valuable than the metal."[2]

The most likely reason that uranium disintegrates at a slower rate than radium and radium than helium lies in the consideration, left entirely out of count by Soddy, that existing nebulæ give us the hint that the formation of atoms in interstellar space is not yet a thing of the past, whilst the formation of chemical compounds on this earth seems to suggest that atom-building probably also goes on here; and that therefore if it so be, then when the atoms of an element first start disintegrating according to the theorem stated by Poynting (*vide* pp. 59 and 81) or peradventure to a modification of Fraser's system (*vide* pp. 356-7), they have primarily to overcome the constructive forces and comparative inertia before destructive forces can come into play. It is a somewhat analogous position to an electric current which, before it circulates, has to overcome the resistance in the wire. It is far easier for radium to become helium, than for uranium to become radium. It may not be long since first uranium started disintegrating, and it may continue to do so at a continuous acceleration. The conditions on our globe, especially of pressure and of the amount of free electricity, are perpetually

[1] "Journal of the Inst. of Elect. Engineers," August, 1906, p. 144.

[2] *Ibid.*, p. 146.

altering. There is no reason for Soddy's dogmatic assertion[1] that "radio-activity is an intrinsic property of the element." When its atoms had formed, a certain lapse of time was necessary before resistance could be overcome. During this lapse of time there could have been no disintegration.

Absolute stability, whether of physical, chemical, mental, or moral characteristics, is an illusion.

One corollary hereto is that *absolute rigidity is an illusion.*

That everything is changing, that all is fleeting, is a conception which presents a very pretty moral. It says: 'Be quick at coming to your conclusions.' Once the mind is made up, and made up for good, do not procrastinate; but act in the living present, act before the conditions become so altered that if carried out at all, that act of yours will have an effect utterly different to what you originally intended that it should have. You are in the good-tendency current now, use your opportunity. Do you know in what ills you may in the future be forced to take a part?

This conception of omnimutability throws a strong light on the question of 'have we lived before?' Although much that has been said about it, or rather in support of it, is to a great extent explained or more correctly explained away by ancestral or hereditary memory[2] (*vide* pp. 294-296), by the remembrance of dreams or perused literature, yet in another sense an affirmative reply might be given. Whilst denying *in toto* the incarnation of the transmigration of souls as an absurdity not for a minute to be harboured, a soul being *per se* non-existent, yet at some time within infinity either in the past or in the future this body of ours must assuredly come together again and in *nearly* similar circumstances *except for some slight variation* (*vide* pp. 226, ¶ 3, and 228, ¶ 1) either of ourselves or of the environment. This is sure to be, by virtue of omnimutability by which each permutation and combination of an infinite number of forms must come to pass and thus the existence of this body of ours, *except for the want of, the addition of, or the substitution of* some infinitesimal entity is a possibility. The number of times in which we shall altogether come into existence as the relative individual we are, is, I should say, limited to the number of force-forms of which our body is composed and of other existing or existable force-forms which could coalesce with it without detracting from our conception of individuality.

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[1] "Journal of the Inst. of Elect. Engineers," August, 1906, p. 141.

[2] A good article on this subject is by the Rev. Forbes Phillips in the "Nineteenth Century" for June, 1906.

Every combination, I repeat, is possible, but each force-form has only certain attributes, and as long as the respective force-form exists comparatively in its original condition, these attributes cannot to any great extent vary, and those force-forms which went to produce us can therefore only do so as long as their attributes are comparatively constant. This too therefore is a limiting factor to the number of recarnations[1] or re-forming to flesh of the forces. We must not hope, as Nietche says, perrotatorily, *i.e.* for ever at stated periods to put in an appearance to see how things are getting on, and our inquisitiveness will have an end. How very different have been the views, even of biblical writers on these subjects is best seen by a comparison of Timothy, Daniel, and Isaiah. 1 Timothy vi. 16 straight away denies immortality to aught but a divine spirit, external to man. There will thus be no permanence of a human body nor of a human soul. That it may not in the defence of this passage be said that the soul is part of 'the Lord,' I would only ask you to consider that a god, as defined by the majority, is infinite, whereas the 'soul,' being encased within the body, would be finite. Daniel (xii. 2) compromises somewhat, and contends that while some are to die an ordinary death, 'many,' but not all, are to awake again to an everlasting life either of joy or shame. Although not expressly stated, it appears to be implied that the awakening to an everlasting life will be an awakening of the soul or of the intelligence but not of the body. The phraseology is however rather ambiguous. Isaiah (lxvi. 23, 24), on the other hand, is very explicit, and conceives the horrid notion that the bodies of certain sinners, although cankerous and putrefying, shall continue to corporeally exist in perpetuity, as a warning and "an abhorring unto all flesh," which were distinctly opposed to our conception of sempermutability. It were though, in accordance with the statements of others writers who will have it that Enoch and Elijah have, and many Christians will ascend bodily into heaven without dying. Although, as illuminated by the science of to-day, I can at present see no reason for assuming that the recarnated[2] forces can have any remembrance of their prior companionship, or a conviction that they may meet again, or that their reappearance will or can have any bearing on prophecy (*vide* p. 297), yet on this point I express agnosticity.[3] To be frivolous:

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[1] A self-coined word, and not at all in meaning allied to reincarnations.

[2] To form to flesh again, to re-form to flesh.

[3] The question of remembrance has been touched on when treating of 'double consciousness' (pp. 296-298), and inherited memory (pp. 294-296), but the remarks there could of course have no bearing whatsoever on the remembrance of former

"Thinks I, 'Aha!
When I can talk, I'll tell Mamma.'
—And that's my earliest recollection."[1]

Recarnation can only be denied by deniers of omnimutability, by supporters of the view that there exist but a given number of force-forms, consequently a limited mutability, and that this given number of changes is repeated in series to all eternity; or by disbelivers in infinity.

In infinite force-forms there exists an infinite number of permutations and combinations, and therefore *homogeneity is an illusion.*

* * *

There are two expressions which still await precise stating: those of 'nature' and 'laws of nature.' Darwin's definitions[2] of nature and law, being, I believe, those usually adopted, therefore deserve quotation.

> "I mean by nature only the aggregate actions and product of many natural laws;—and by laws only the ascertained sequence of events."

Darwin maintains that a law is a sequence of events, which declaration is hard to uphold. A law, in physics, chemistry, and natural philosophy, is a statement of the order in which certain events which, in the end, produce a given effect, are observed to take place; or better,

A law of nature is the statement of the observed series of causes and effects in order of succession, which it has been found as the result of experience must have come into existence in that order to produce a given final result.

As a law of nature is simply the specification of an observed uniformity of action under a series of similar conditions: a law, being a statement, cannot act, nor can there be additions or products of statements; and therefore nature may not be described as 'the aggregate action of laws' or statements.

Nature is the collective expression for the sum of all the series, individual and combined, of causes and effects in order of succession which the force-forms of the universe individually and collectively underlie as the result of the characteristics or attributes of the

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existences separated by periods of time greater than the age of mundane intelligence. Arithmetical prodigies, such as Zerah Colburn, "The son of an American peasant, who, without having received any arithmetical education, could at the age of eight answer almost any arithmetical problem, and knew, for instance, without any calculation, that 4,294,967,297 was not a prime number, but the product of certain factors" ("Daily Mail," July 25th, 1906), are most likely cases of inherited memory, although there are no positive data upon which to base any surmise.

[1] F. Locher, "A Terrible Infant."

[2] "Animals and Plants under Domestication," p. 6.

separate and combinations of force-forms which constitute the conditions.

If any phase or phases of nature be observed under varied aspects, *i.e.* if different causes be attributed to the same events in the same order, then can other laws be deduced. One's idea of nature is constantly undergoing change. A law of nature is only so long true as there exists belief therein. For those living in any epoch, the order of Nature of the previous epochs is topsy-turvy (*vide* p. 64. Compare also p. 66 and the footnote to p. 80).

For us mortals, natural law exists, *i.e.* we assume it, for each force possessing apparently its own specific characteristics, it can only act in certain ways on other forces and other forces on it. That it and they cannot act otherwise is self-evident, natural, and therefore we can, on noticing given forces at work, always in a general way be able to prognosticate a given result. Speaking however in absolute terms, *natural law is non-existent*, is an abstract abstraction, for the universe being in a condition of perpetual and eternal change, immutability of any sort—so also of natural law—must be an illusion only (*vide* footnote to p. 26). No force at any moment is exactly what it was a moment previously; nature is ever changing. Yet the countless vicissitudes in the existence of force occur so extremely slowly that man's senses record no change. One has only however to successively think of and compare the general characteristics underlying the actions of force which must have existed before matter came on the scene, during its advent, which obtain during its presence, and which will probably be acquired posteriorly to its exit, to at once perceive that no fixed natural law is possible. Consequently **there is no such thing as the much vaunted immutability of natural law.** Even a sliding scale is out of question, for it would entail the elimination of all factors not included in this proportion and be contrary to our conception of infinity.

All which is real is also necessary (*vide* p. 38), and therefore even this conception of the abstract abstraction 'natural law' and its immutability is necessary. It appears requisite for the purpose of regulating our actions and our mode of living, of obtaining all that which goes to make life enjoyable. With it, however, there is also a capacity for doing injury to one's self and others, even to annihilation, and yet herein may be a purpose.

* * *

Although we accognise personal intelligence and its philogenitive consciousness in man and brute, there is no such thing as a general

or a cosmic intelligence nor a universal or cosmic consciousness (*vide* p. 290). The idea or the conception—certain persons are said to hear the divine voice, to see the holy flame etc.—of an omniscient spirit, call him a god or what you will, is either an illusion or an hallucination, as the case may be (*vide* p. 283).

There are human beings who have neither conceptions nor ideas of a divinity. Such, for instance, are the Hairy Ainu, who, although evincing some sort of totemism of their ancestor the bear, maltreat and eat it: they never worship it. The implements which are buried with the dead owner are not placed in the grave to be used in a future state, for they are first broken so as not again to be employed. And this supposed descent from a bear just reminds me that it has now, on mostly palæontological but also other considerations, been shown that most probably not only all modern marsupials—whose feet exhibit

> "traces of the former opposability of the thumb and great toe to the other digits,"[1]

but all mammals had an arboreal ancestry or ancestors of one common stock, small in size, who were climbers. This discovery is due to the labours and untiring energy of Dr. W. A. Matthew.[2] These small quadrupeds were, among other peculiarities, provided with

> "five toes to each foot, of which the first was more or less opposable to the other four."[3]

Thus there is here again a connection between mythology, fable, and science. The Transylvanian gypsies are fond of relating the story which I here epitomise. 'In the beginning, all was water. Into this water God threw his stick, which became a tree, under which sat the devil. The devil is ordered to fetch sand from the depths, out of which God will make living beings. The devil fetches the sand but wants to make the living creatures himself, and is for nine days in succession, burnt more and more by the sand. At last he gives it to God, who makes out of it the globe. There is then a dispute between God and the devil, which ends in the latter being carried off on the horns of a huge bull. From the tree, flesh fell to earth and human beings sprang out of the leaves. The germanic mythology, too, narrates that Ask and Embla, the first pair, had their origin in the trees. The Bible also speaks of the tree of life, and

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[1] R. Lydekker in "Knowledge" for April, 1905.

[2] "American Naturalist" for Nov. and Dec. 1904, p. 811.

[3] *Vide* footnote [1]. Comp. also the first two sections under the art. 'Zoological,' for Sept. 1905.

earlier yet in the world's history is a Babylonian story which is pictorially recorded on stone, of a first pair sitting under a tree.

But we are not here discussing either mythology or evolution, but intelligence or rather its want in the cosmological entity.

Notwithstanding that everything serves a purpose (*vide* Bk. i., chap. iv.), or as Hegel expresses it,

"Alles was ist, ist vernünftig,"	"All that is, is reasonable,"

no acts save those of mankind and brutes are done even apparently for a purpose, and thus purpose in man is only apparent (*vide* p. 292). In cosmic ex-animal existence there is no directive intelligence (*vide* p. 288). There can be no god either of justice or of injustice; there can be no omnibenignant spirit, no Shekinah over the mercy seat. It is interesting to note that the Arabian Moslem, when sacrificing, never says, 'In the name of the merciful God,' but

"Bismillah! Alláho Akbar."	"In the name of God."

And as, as a rule, the proverbs or wise sayings of a nation, tribe or caste, which are freely and generally circulated among them, are a fair standard by which to gauge their innermost feelings, bias and propensities; it is not a little instructive to hear in what small regard the doing of good and even divinity itself is actually held by Hindustani Mohammedans, as expressed in their

"Sattah chuhe khake Billi Haj ko chale."	"Three score rats and ten puss devoured, and then—set out for Holy Mecca."

To what extremes of cruelty nature sinks (?) is seen in the gruesome and repulsive acts of the crows of Yezo[1] which will, when they see a young horse, fly down and peck out its eyes, afterwards bit by bit devouring the poor, distraught, excruciatingly suffering animal alive.

Then if naught is done for a purpose, but yet everything has a purpose (*vide* p. 107, *et seq.*), then the grist of the matter seems to turn on an answer to the question, asked on page 113, 'What is the purpose?'

Let us consider certain impossibilities. By mounting Pegasus and taking a long flight of fancy we arrive at an on all sides enclosed cubical space for which the dimensions had been reckoned prior to its isolation and within which is a certain quantity of chemical compounds of special kinds with a previously calculated amount of

[1] *Vide* Landor, p. 146.

air, all so computed that the products of the decomposition of each can be absorbed by others of the group, and this interchange is herein going on to all eternity without detracting from or impairing the individuality of each. Soaring higher, our imagination reaches a yet more singular region. Here it had been estimated to a nicety how many animals of given kind and how much soil, vegetation, water, and atmosphere were requisite to maintain a perfect eternal equilibrium within a pre-determined area. That is to say, decomposition and accretion or assimilation, exhalation and inhalation were maintaining an exact counterpoise. Of course such conditions of perpetual balance cannot actually exist, for no account is taken of reproduction and so on, and exterior stimulæ would upset the working of the entire mechanism. But these two self-conjured up illusions are sufficient to illustrate the idea of a limited number of force-forms of the One Force maintaining themselves to all eternity. Stretch the analogy to an infinite number of force-forms filling an infinite space and each upholding the movement of the others to all eternity, so is it at once evident that what was impossible to the limited groups, is actually the *status quô* of the infinite ones (comp. p. 113). No intelligence is here necessary. The entire system is mechanically regulated. There is a mutual exchange of degrees of complexity. Sometimes there is a tendency to an increase of heterogeneity, as when living things assimilate; sometimes, as when the breakers and undertow of the sea produce in a mixed assortment of coarse and fine, large and small stones, an increased uniformity of size, shape, and polish, there is a tendency to a state of comparative homogeneity; but perfect homogeneity remains a delusion. The purpose of the action of each force-form is for the maintenance of perpetual motion of the entire; but as there is no cosmic intention, each act is not purposefully set in function to that end nor does any act itself act to obtain an end. The universe is easily and simply described as '*id est*,' living out its characteristic of motion.

The RAISON D'ETRE of each action is for the perpetuation of all action in infinity to all eternity. I said 'each action,' but actually there is no such thing as an individual force (*vide* pp. 104, 106, 107). It were contrary to my conception of an elastic universe (*vide* p. 356). Such an idea as that of separate actions is necessary to our reasoning about the universe, but is quite arbitrary; and the limits which are entailed by 'an act' are the results of pure imagination and have no real existence, since force, being infinite, it is continuous

(compare p. 84, ¶ 1), and our picking out of a momentary phase, *i.e.* a phase within a conceivable lapse of time which we call an act, is absolutely at our own discretion or fancy. The above statement can be re-formulated thus :—

The RAISON D'ETRE of each phase of force to infinity, i.e. the raison d'etre of the sum of the phases or the entire is for the supreme end of self-existence.

Everything that is real, *i.e.* that exists, is necessary: that means necessary to upholding the condition of motion. Everything which will become necessary to sustain motion will in due season be real, come into existence. But although causes and their effects are infinite, and therefore everything possible and bounden sooner or later to come to pass, yet not at random, not by chance will aught take place, for every force-form has its own specific characteristics, its definite nature, so that each act can only take place in a given order in a given time. This order and this time are absolutely necessary to the taking place of any function, and it will not be there till it is necessary. When necessary it will be there. There is no chance in anything.

Even our thoughts do not ever really 'wander.' Force is one continuous whole: it is an entity. This being so, each part of the infinite whole—and our mental system is hereof a part—is bound or regulated in its movements by the other parts which have again been acted on by others no longer existing, but which, nevertheless, were the cause (*vide* p. 96). Each action being the resultant of two or more components, and these being again resultants of other components, there are certain things which momentarily can be done, and certain things which cannot be done, and the brain can no more think independently than anything else. As Büchner is here in accord with Haeckel, it is scarcely a misinterpretation of the former to substitute the word 'intelligence' for 'soul,' and say: Intelligence

"ist ja kein *ens per se*, keine metaphysische Wesenheit, sondern nur der Ausdruck für die mannigfaltigen Verrichtungen des Gehirns und Nervensystems."[1]

"is no *ens per se*, no metaphysical being, but only the expression of the manifold functions of the brain and nervous system."

These functions are quite mechanical and underlie exactly the same laws as all other of the force-forms. Des Cartes' celebrated phrase,

"Cogito, ergo sum,"

"I think, therefore I am,"

[1] Büchner's "Licht und Leben."

should read, 'Because I am compelled to think, I am.' Intelligence in the animal and more especially the human intelligence, subordinates it is true many forces, yet more forces subordinate it. Mental actions can therefore never be arbitrary, haphazard in their functions—are never the result of chance. To repeat, they take place strictly in accordance with the definite characteristics or attributes of the All-Force, in a sequence compatible with its nature; but the enunciation of the relations which subsist between these mental actions and such characteristics, attributes, qualities, or nature, *i.e.* the establishing of a precise formula to express them is rendered momentarily impossible by virtue of their extreme reconditeness and of our exceedingly limited knowledge of them.

Heredity, education, environment,[1] the occupation to which each person is put, defines his state of health and in a sense his intellect. And it has been shown that intelligence is on the decline. (*Vide* pp. 312-315.) Hegel had the illusion of the existence of panlogism or the absoluteness of thought. To Aristotle,[2] that nature was full of reason, was a hallucination. Dr. James P. Lynch of Chicago has estimated[3]

> "that one half of the civilised world will be insane five hundred years hence under the present conditions of living, and that in two hundred years most of the Caucasian race will be mentally deranged."

This, of course, is not to say that there is a complete loss of intelligence, for a maniac thinks. But even this thought will cease. One scientific fact especially may prove significant in pointing out a cause for mental obliteration. When, for experimental purposes, nerves are removed from the body,

> "drying at first increases the excitability, but afterwards rapidly decreases it."[4]

As our earth cools, water will become scarce, the nerves too dry, and our mental system will consequently suffer. McCabe's 'great questions'[5] as to "Whether this mechanical evolution of the uni-

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[1] How climate (temperature) affects the nerves is seen, in that the duration of the life of a nerve after its removal from the body is 22-24 hours at the normal temperature of the nerve, but a few hours at 44°C. and only a few seconds at 75°C. (*vide* Rosenthal, p. 280). This accounts for weak mental capacity among the races of sub-tropical climes.

[2] *Vide* his bk. ii. of the "Physical Discourse," φυσικὴ ἀκρόασις ἢ περὶ ἀρχῶν.

[3] *Vide* "Daily Mail," Sept. 16th, 1904.

[4] Rosenthal, p. 124.

[5] *Vide* the art. 'Sir Oliver Lodge on Haeckel,' by Joseph McCabe, in the "Hibbert Journal" for July 1905, p. 748.

verse needed intelligent control and whether the mind of man stands out imperishable amidst the wreck of worlds" have herein found a reply. Apart from animal life, there is no intelligence, and the intelligence of animal life will never supremely direct the actions of the universe, since intelligence dies out before life becomes extinct, and even living organisms will cease, being the losers in a futile fight against an infinity and eternity of ever-changing force-forms which will metamorphose them into other to us inconceivable existences.

Again, to adopt the catechetical: How then, since it must die out, can intellect serve a purpose? In the first instance, every form must in turn be destroyed to give place to another of the infinite forms. Next, it is extermination of the one which permits motion to the other: there is space in which to move. There is no sudden cessation, and the transfusion in any part of space is gradual and eternal. There is an incessant unbroken passing out and a passing in. Lastly, there is no action without reaction. The knowledge of an action of gradual intellectual extinction, or even the idea of it, will be fearful, revolting to many of you. Fear begets action. Seek to prove that intelligence is not dying. It will not alter the fact, if fact it be, but pen and ink and paper and brain will be in requisition, the printing-machines will rattle off an anathema at the daring individual who had ventured to challenge the constancy of intelligence and—motion is perpetuated.

Our place in the universe is now clearly defined. The universe is serving no purpose save that of existing. It is *per se* perfectly unintelligent. We are a part of this force-universe, assisting mechanically in sustaining the whole. We have intelligence, but intelligence *per se* as intelligence in no way helps the maintenance of the entire, although it, like and as all other force-forms, forwards this end. "Proud man" is but

"Drest in a little brief authority,"[1]

which dwindles to a hapless close and therefore is of no higher importance than any of the other forms, but on a footing of equality with them and they with each other. We have come into existence as an aggregate of certain definite force coalitions. These coalitions are mutable; and when they in due course break up, we human beings will be in existence no more and our intelligence will have ceased to exist with us. Our standpoint is that our parts, as modes of force, have ever been and they will be from now henceforward to all eternity.

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[1] Shakspeare: "Measure for Measure," act ii., sc. 2.

"But what about prayer?" you all cry at once. "Was not, at the outset, your watchword, 'Search the scriptures, watch, and pray'? (*vide* p. 4). Did you not promise to tell to whom to pray (*vide* p. 6); and did you not at last tell us that we had to pray to the 'Universal Force,' to the 'Omnipresent Eternal One'? (*vide* p. 174). Yet now it would seem there is none to whom to offer our supplications, seeing that the All-Force understandeth not. Have you all this while been befooling us?" I hear you clamour.

No, dear readers, no. Not so is my wont. I am the very last person in the world to chaff you. I own up to a slight Machiavellianism in the sense of at first discreetly cloaking my own views and expressing myself apparently against what they are known to be, and ironically (although you did not know it) advising you to do that which I knew would be most palatable to you although to me it would be worthless and silly—that is all. But had I at once shown my cards, given you the ideas, which many of you I now hope hold with me in common, there would have been no limitation to your baseless vituperations, and your biassed wrath would have known no measure. Above all, my tactics were necessary to, and have been fully justified by, the results.

> "Horse and weapon, lute and volume, man and woman, gift of speech
> Have their own uselessness or uses in the one who owneth each,"[1]

and this little ruse to which I plead guilty was useful or purposeful to me, for I know the religious proclivities of my fellow-countrymen, the English, too well not to be aware that had I not taken their little susceptibilities into consideration and been less cautious, my book would, in all probability, after the perusal of a few pages, have been tossed aside as highly sacrilegious and blasphemous, and dissemination of the golden truths therein contained would have been utterly impossible. As it is, you have unprejudiced and peacefully read the work through and followed its proofs bit by bit to their logical conclusion, and *volens nolens*, despite yourselves, unwittingly been converted. It was to this end I had seemingly to speak slightingly of one who, I expect, will turn out to be one of my staunchest adherents, but whose opinions are so well known, that, had I at once called him friend, I should have trodden on a hornet's nest and brought the stinging little creatures about my ears. To this man, with ample apology, is

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[1] Proverbial Wisdom from the Shlokas of the Hitotadésa, written about 350 B.C., and translated by Sir Edwin Arnold, M.A., K.C.I.E., C.S.I., in his "Indian Poetry," p. 250; pub. Kegan Paul, London, 1891.

now offered that reparation which I know will appease him best: the true and simple statement that Mr. Foote—for it is he to whom I refer (*vide* p. 7 and its footnote)[1]—has, through the medium of his journal, "The Freethinker," done much in my earlier days to mould my brain and—this work is the fruit. I trust he is satisfied.

Prayer has though, not been entirely without profit even to you, my readers. Due no doubt to the damaging effects of insularity,[2] you have many little weak points. You prayed for strength to solve the riddle of life (*vide* p. 175).

"Pars sanitatis velle sanari fuit."[3] "The wish to be cured is a part of the cure."

It matters not whether you pray to the sun or idols of wood and stone or to angels (Sabianism) or to the saints or to Mary or Jesus or/and to a spiritual God—you will have the same result. Your earnest solicitations will not have remained unheard, for they autosuggestively put a spur to your efforts to reach the goal.

"No man ever prayed heartily, without learning something."[4]

One can only learn by experience: and one thing to be learned by hearty praying is the uselessness or useless aspect of prayer, for, apart from action instilled by prayer or by a prayer being by other causes followed up by that for which was prayed, petitions to an illusory spiritual being must perforce remain in abeyance. Once this has been grasped, we shall no more waste our time in vain implorings, but act at once. Just fancy an omniscient and omnipotent God, a God who

"knoweth what things ye have need of, before ye ask him,"[5]

and knoweth what He is about to do, changing His will on the, in this sense, worthless supplications of one of His mortal creations. I must admire the keen satire of the Frenchman[6] who wrote:—

"Que votre volonté soit faite,
Dieu clément et la mienne aussi."

Engl. "Merciful God, thy will
Be done,—and mine as well."

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[1] Compare also p. 3, ¶ 1, and the footnote thereto.

[2] Accognising you were mentally not so strong as in another climate and with other opportunities you might have been, seeing you were insular, with but few broad or expanded ideas, and therefore not quite wide-awake, yours has been the happy (?) dumping ground for nigh all the theological and philosophic charlatans which both the old and the new world has ever known, and you have thus been withheld from the fruits of progress which have in such high degree been enjoyed by the rest of the civilised community.

[3] Seneca.

[4] Emerson, 'Nature,' chap. viii.

[5] St. Matthew vi. 6.

[6] Delavigne, 'Louis XI.' act iv., sc. 7.

Never was this fruitlessness brought more home to the world generally than when in the last war the little Russians on their bended knees before the consecrated ikons cried for divine aid against the Japanese :—

> "We must tear Port Arthur from the grasp of the Nippons. But if we are to succeed in that enterprise, nothing but hope in Almighty God can help us. The people must pray for the safety of Port Arthur as the Woman of Canaan prayed for her daughter. Let the heavens ring with the cries of souls in pain, cries not heard on earth but heeded in heaven." [1]

But a certain Ethiopian preacher could tell you yet more of the futility of prayer, for, according to a Durban telegram to the "Daily Mail," [2] he was

> "sentenced to six months' imprisonment and twenty-five lashes for offering prayers of a seditious character in a native kraal. The prayers were to the effect that the natives should be given strength to drive the whites across the sea."

The above is a proof that even in such a religiously conducted dominion as the British Empire, one must not pray for what one wants, but for what one may. The interests of the Mother Country rank higher than a creature's prayers to his Maker. The entire system of public prayer is seen to be replete with mockery. And yet it is this very public prayer that unites the units of congregations, that has up till now, in place of anything better, taught us the brotherhood of man,—it is its ethical value, for which we cannot be too thankful. We have prayed together, forgotten our petty feuds, and together sought to give advice to the erring, to help the needy, to dispense charity, and to disseminate the seeds of morality. Since, however, a quick printing system, speedy and easy methods of transit and freedom of speech are daily advancing, since the gramophone, the phonograph and the bioscope can impart to thousands at a time the knowledge that has been gleaned in far-off lands, and since we can help each other with advice through the telephone, by post, as well as by wireless telegraphy (both of which systems are in stages of rapid progress), banding together in congregations, which even from a hygienic standpoint was much to be lamented, is daily becoming less and less necessary and will, like all else, slowly but surely cease to be. Civilisation has brought it about, that distance is no longer an overwhelming obstacle to regular

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[1] Extracted from the "Viedmosti," Moscow, by the "Daily Mail," Sept. 30th, 1904.

[2] For Aug. 11th, 1906.

intercourse, and we need not personally come together in order concerted to act in harmony.

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A few words of retrospection and valediction, and these last shall be words of advice.

I had become dissatisfied with the lazy mental attitude which I had hitherto taken up towards the trend of general thought in the world of modern science. True it is, that once and again some desultory incursion into this mystic land has been undertaken, when here and there a work or two had been at random picked up as I came across them; but as these not seldom contained expressions of sentiment widely divergent, no general opinion was formable. That these diversities, though to all appearance unreconcilable, could yet be shown to have their place in one common scheme, surpassed my comprehension. It was only by a strenuous application at an organised collating and sorting all dissentient and dissimilar as well as all concordant and collateral evidence on each point at issue, and, wherever possible, verifying otherwise doubtful statements, that anything approaching to a clear notion of the harmony which exists even in apparently most unlike and opposed schools of thought, could be obtained.

Having attained this stage, it was felt to be a duty to undertake the very arduous but most pleasant task of acting as the readers' cicerone over the tracks that had been made. This self-imposed labour was one of love, and has now been accomplished; but most of you may probably feel that one further step must be taken, before the goal, which has been reached, is actually in your grasp.

I have been told that it is far easier to destroy a belief than to impart one; far easier to debase than to raise the moral sense of a nation. It is my experience, that in this, as in all like statements, there is a modicum of truth and a fair share of untruth.

Members of uncivilised races are comparatively easily persuaded of the errors of their opinions, for they are only in part based on a tuition which is casual, optional, and unsystematic, whereas the great bulk is founded on personal experience, gleaned from the phenomena of nature, dreams, and the like. It is this freedom of thought, this quasi-independence, which permitted so rapid an evolution of religion and laid the fundament for all the main religions of the present civilised world, for each individual was at liberty to propound his own view of the case under conditions which were much more favourable to its acceptance than would be possible now.

The facilities for propagating anything not scheduled and docketed gradually diminished as a priestly caste grew. It is comparatively within the last few years only, that creeds have quickly grown in number. The early brain, being in formation, was more pliant than that which has evolved to-day. Another reason for the light conversion of primitive peoples is to be found in the mental weakness of the subjects, who are unable to tackle the trained intelligence of the more highly cultured, and quickly tire. Even among us, a feeble intellect is sooner persuaded, more easily influenced and won over, than is a strong one. When, however, civilised man generally is considered, one comes to quite a different conclusion. Here, everything in any way pertaining to or that could in any respect be made an adjunct of religious material has been systematically organised as 'religion,' and, as a special subject of instruction, taught the masses singly and collectively for centuries. Not only this, but churches and governments have compelled the adoption of special creeds with fire at the stake, with crucifixion, at the edge of the sword, and with imprisonment. The uncivilised nations, though may be practising petty ceremonies such as those of dancing and singing, had no conception that the subject of their devotions could form a thing for study, a topic of tuition, a something to which they were compelled to conform. (Compare the facts of medieval religious persecution with modern excommunication as practised on poor Count Tolstoi, and such a fact as that set forth on page 4 in an abstract from the "Bangkok Times.") Priests by degrees obtained the upper hand and ruled with a rod of iron. Woe unto the luckless wight who should oppose the trend of the religious thought of his times. Religious ideas have been so inculcated, so forced, so to say, into civilised man, that religious proclivities have become part of his nature and hereditary—and further indoctrination is going on. So imbued are the majority with the teachings which have been implanted within them, and to which they mechanically adhere, that prodigious efforts must be exerted before any success in an opposite direction can be expected. It is moderately easy when once the stone has been started rolling, but it is heavy work to set it rolling. It is far more difficult to destroy this mighty organisation, hallowed by antiquity, and to annul its effects, than it is to build up a rational edifice of common sense, based on the independent results of modern science.

There are, however, unmistakable signs that the task has been simplified for me, in that, following the usual course of things in virtue of their mutability to undo those complexities they went to

build up, the force-forms which have hitherto been the support of religion have started disintegrating much after the manner that the atom has started disintegrating. The inquisitiveness of the masses on all subjects relating to religion, as seen in the number of newly founded sects, the modernising of Asiatic principles in Europe, the liberal treatment of rationalistic views in such journals as the "Quarterly Review," "Nineteenth Century," "Philosophical Magazine," "Hibbert Journal," and the like more, the materialistic colouring given to University Extension and other lectures and to the subjects of contention in many debating societies even in direct connection with a church, the free discussion of individual creeds side by side with that of atheism in Hyde Park—a public space belonging to a once bigoted and priest-ridden country—the question of the separation of Church and State which has been mooted in the British Isles and pluckily and bravely carried out in France, the advertisements and placards, flaunting their special creeds in the eyes of the passer-by, which are displayed at every church and chapel porch, offering songs and music, teas or a smoking meeting as an incentive to enter the holy (?) precincts, unheeding the world-wise motto that 'familiarity breeds contempt,' are one and all unmisinterpretable indications of the decay of religion. Not only does familiarity with religious matters lead to their contempt, but the very fact of so often repeating the commandments, the creeds, or expressing feelings of submission and of humility, so often swearing to one's belief in a deity, must in the end lead to mechanical observance in the weakly- and to doubt in the strongly-minded. Is it not the same with the perpetual reiteration of expressions of love between husband and wife? Do those love each other most, who on the one side are always asking, "Do you love me, dear?" and are being answered on the other, "I love you and only you"? The deep waters are still. The married woman who boasts of her happiness with her husband is not the joyous wife she intends you to think she is, and that mother errs grievously who deems those children regard her most who are the loudest in their vociferations and most lavish in their display of affection.

There is still another disintegrating factor of religion—decentralisation. There are so many priests that there can obviously be but few hearers to each lecturer. As, too, these lecturers are seldom quite in agreement with one another, it stands to reason that very various ideas are disseminated. Besides, the great secret of the strength of the pastor or preacher of former days lay in the great

size of his congregation, for there is much greater emotional feeling in a large convocation than a small crowd, and emotion and not reason is requisite to uphold religion. The modern rhetorically equipped clergyman and the American organisers of emotion *en masse* know this full well and make use of this knowledge. But the number of hearers will grow less and less with an affirmative reply to the cry that has gone up of 'back to the land,' and those going back will take the wisdom of the cities with them. When means for rapid transit are yet more advanced, when the flying machine is a popular vehicle, and people can live where they like, from whence then will the sermon-monger get together his congregation ?

The dismemberment on these lines of the body ecclesiastical and the death throes of religion are subjects which should prove a good background for a new tendence novel. I advise the novel, for it is the greatest of all modern means for getting a firm grip both of the reasoning and of the emotional faculties of mankind—and of womankind. Man may not always respect woman, at least not openly own up to it, but he nearly always does so privately, not seldom asks her advice, and is ever somewhat under her influence, and this woman is the great reader of novels. I remember decrying the employment of the emotionalism of women to propagate religion (*vide* p. 139), and yet you find me recommending their advocacy as the best curative agent for mental myopy that is to be found in the entire rationalistic pharmacopœia : *tempora mutantur* . . . .

But however much such side-issues may interest us, we must keep to our theme. We were saying, that although it was no easy matter to tear down the prejudice of centuries, nay more, of several thousands of years, it was nevertheless materially facilitated by the decentralising trend of recent years. I therefore hope that it will not only be posssible for me to take away but to substitute, not only to weaken but to strengthen—and our strength lies in taking note of ever-changing circumstances and changing with them, of our adaptability to conform to them.

I showed cause (*vide* p. 342) why all thought should be concentrated on how to act in the living present, with little or no regard to the past or future. Only the present is ours.

> "The present is the living sum-total of the whole past." [1]

We have no soul to look after, and have quite enough to take care of ourselves. This is no excuse to be wicked. On the contrary,

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[1] Carlyle's Essays, "Characteristics."

knowing our common lot of dissolution, we feel drawn together more sincerely than if wrangling who was first to be in Heaven.

> "I expect to pass through this world but once. Any good thing, therefore, that I can do or any kindness I can show to any fellow human being let me do it now. Let me not defer nor neglect it, for I shall not pass this way again." [1]

It was seen that in the present state of our ethics, we seek justification for our deeds (*vide* pp. 301, 302). The thief seeks to justify his act of theft. The evildoer most likely advances a plea of revenge for his deed, and this revenge is to him justifiable, it satisfies his sense of desideration, it is to him (although not to the sufferer and those to the latter in sympathy bound) right, and he declares with all and true sincerity that had you been in his place, you would have done likewise. What one person calls right, another calls wrong. What to the one is highly laudatory and an act of grace, is to another utterly damnatory and a sin. All depends on the point of view (*vide* p. 301). The social-democrat finds it a literal sin and an injustice against himself, his family and his kind, that the rich man holds on to his thousands instead of distributing them. As a punishment, says the former, the rich man is to find it far more difficult to get into heaven [2] than the poor man, aye, far more difficult than for a camel to pass through the eye of a needle.[3] As, with sane beings, it is always sought to justify an act, there is concomitant with each act, the exertion of a certain amount of intelligence. From the point of view, therefore, of the spectator, not of the actor, no crime can be perpetrated without understanding, whereas, from the standpoint of the actor, no sin can be committed with reason.

From my vantage ground, every one should so act as to get as much happiness out of the moment as the moment can produce. Some seek to make others happy and therein find their own happiness. Others seek firstly to gratify themselves. Both may be right. Our system of ethics does not suit every race, nor is it a panacea for all society's ills.

> "The pure Ainu are comparatively honest people, which may be due to the incapacity for being dishonest." [4]

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[1] Steven Grellet.

[2] What good is it to get there? I cannot quite conceive, for, like all else, the heavens being mutable, says Peter, will come to an end—or to use his own words, "The heavens, being on fire, shall be dissolved."

[3] Comp. St. Luke xviii. 25.

[4] Landor, p. 272.

Falsehood and truth are not known to the Ainu and other savages, and they answer questions as they think will please the interrogator. But with more intelligent races, such as the *Z*ulus, crime is common, and it is civilisation and education which have made a once harmless folk cunning and treacherous. Again,

> "A high moral standard, whether got from philosophic breath or Christian virtues, does not suit a despised barbarian race like the Ainu. Nothing could or does kill them quicker than civilisation. Experiments have been tried to civilise certain Ainus: they were made to wash, bathe, and to live in comfortable quarters. They were instructed and given good food; but after a few months they had to be sent back to their native place and ways, for civilisation only killed them."[1]

These facts sufficiently demonstrate that that code of ethics should be chosen which is most in conformity with the natural propensities of those who have to obey it, and which most benefits them corporeally and mentally (*vide* p. 301, ¶ 3, and p. 302), but not spiritually, for a spirit or soul is non-existent and an hallucination.

Some people have not only no sexual proclivities but sexual aversion. Such should not be given in marriage, but should live aloof. Some are satisfied with one mate. Let them find such mate and happily live together.

> "Enjoy life with the wife whom thou lovest all the days of the life of thy vanity."[2]

But, according to very many authorities, the majority of mankind—even those practising monogamy—are naturally polygamous. Were it not for moral restrictions, most of us would openly acknowledge that to which we acquiesce in secret. To my mind, it is a sin to openly in the pulpit denounce those who seek to live a life which will make them happier and healthier; and immoral to go against the trend of nature, which is undoubtedly in the direction of unravelling the skein and reverting to primitive modes of connubiality. Several English doctors—under promise not to divulge their names (a specifically English trait to desire to appear otherwise than as one is and fearful to call a spade a spade)[3]—have told me that in

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[1] Landor, p. 269.

[2] Ecclesiastes ix. 9.

[3] One doctor especially was very amusing. After giving me much of the information I desired, he suddenly remembered forgetting at the outset to inquire to what purpose I wished the information. Having informed him, he, in a fright, swallowed up all he had said, although this was of a purely scientific nature, and politely expressed the opinion that every one was a fool who did not act in strict accordance with Christ's injunctions; he would on that account make no charge for the consultation, and again piteously begged me to withhold his name from the public. Do those who would have you to swear as witness, or to take the oath of allegiance to a

general, a man who seeks to restrain himself reverts to masturbation which leads to lunacy and consumption, or failing this, he is naturally relieved in sleep, which is very weakening and quite insufficient, and therefore impure blood and other ailments are the result. How very insufficient the 'dream' relief is, can be deduced from the fact (narrated to me by a military authority who had done such service), that in isolated military stations, such as are to be found on the island of Bermuda, suicide among bachelors is far more common than elsewhere; whilst the married men remain unaffected. Nature punishes its disobedient children. A young woman should marry early, and the evil results of non-compliance are well known to the medical faculty. Women of 28-35 years are more polygamously inclined than their younger sisters. Is it not nigh criminal to neglect to take this into account? To divorce or to ostracise a woman for her natural frailties is not moral but cruel and cowardly, seeing that in the world it is harder for a woman than a man to subsist. The wife, too, must understand the whole nature of man and not be educated up to feeling pain or jealousy at his sexual inconstancy, so long as he is her true friend, mate, helper and adviser. I sincerely trust that these remarks may act paregorically on many an at present unhappy home. Anything harmful to health may be classed as worse than useless. It is decidedly useful to permit freedom of sexual intercourse, for the characters of men and women will be more frank and truthful, having nothing to hide, crime and poverty will be scarcer, and the tendency of the over-indulgence of individuals in this respect and its attendant early senility will be diminished by familiarity with all therewith connected. It is the secret and the hidden, the esoteric, the forbidden fruit that is most sought. Moreover, conjugation being no longer a something to conceal, certain diseases which have hitherto been a veritable scourge will die out, their cause being no longer screened. It is true both figuratively and literally that

"stultorum incurata pudor malus ulcera celat."[1]	"it is the false shame of fools that hides ulcered sores."

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potentate or of conformity with church traditions, obey the behest contained in St. Matthew v. 33-37? Do not Protestants go against the instruction of St. Matthew v. 32 and marry divorced women? It is found more moral so to do, than to shun a woman, to make an outcast of her who may have been unable to check her natural fleshy desires. And so it is with many another command which was suited to other times. Christ's charges to the world are no longer respected, although they worship him still. Oh, the hypocrisy of it all.

[1] Horace.

General copulation is both salutary and useful. It is a virtue to practise only the useful, and as Lecky says:—

> "If what we call virtue be only virtuous because it is useful, it can only be virtuous when it is useful."[1]

To deny one's nature is not useful (at least not to the one denying it, although it must serve a purpose of some kind) and not being useful, it is no virtue. There are, it is pleasing to see, very many who have arrived at the common-sense conclusion that they can best serve themselves and their neighbours, and can therefore be most virtuous, by living a life of pleasure. They exist, and are necessary.

And there are yet other not mentioned benefits which indirectly accrue from such living, profits in which the whole nation have their share. To amply explain the character and magnitude of these advantages, a certain excursiveness will here be indispensable.

In the present state of our existence, relative to the life political and social, and with due regard to the actual nature and propensities of mankind as it is at present constituted (and we are here arguing how best to enjoy the present), a single governing head or chief of an empire, country, province, town, council, club, congregation, or business company—call him emperor, king, president, mayor, archbishop or clergyman, director, manager, or what you will—is not only expedient but absolutely essential. It is in human nature, that each individual has chiefly if not only his own good and betterment in sight, naturally sees in himself only a paragon of virtues and believes that his own ideas of organisation are the only possible paradigm by which to be guided, whilst he just as naturally sees right over his own frailties, the disadvantages of his personality and his principles to the community, and that that which may mean a gain for him personally, may be detrimental to his colleagues at large. To maintain the biological and physiological character, which has hitherto been my main mode of expression, there is therefore in any acephalous body, sure to be dissension, disorganisation, and dismemberment, and, reckoned from the beginning, the final decomposition sets in far sooner than would be the case with more highly evolved organisations. A land given over to ochlocracy would soon be one vast pandemonium.

A head that controls and can overlook all the members, suffers only then no pain when all the separate parts of the body are in

[1] "European Morals," i., p. 45.

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changed (p 397) since writing this. I shall rewrite

agreement, blood feeds the brain and a destruction of the body means death to the head also. It is to the benefit of the head of a community to keep order and to foster content, for discontent is for him equivalent with discomfort, whereas unity brings him and his family a large income and greater comfort. An annihilation of that over which he holds sway were for himself extinction. Yet every force has its effect till overcome, and the ruled must have a voice in the ruling, or else the ruler, seeing the weakness, would take advantage of it and to self-aggrandisement assume despotic sway, with the result that the brain would develop at the expense of the body and equipoise be lost. The well-being of a monarch is conditioned by the weal of his subjects, and *vice versâ* the prosperity of a people is conditioned by the welfare of the king. There is a healthy interdependence.

When Confucius (Kong-fu-tsze), about twenty-four centuries ago, said:—

> "It is a matter of primary necessity that man, as a reasonable being, should live in communities,"

he could not possibly have foreseen that a flying machine, the telephone, and wireless telegraphy would probably decentralise to such an extent that each individual could live on his own favourite plot of ground without losing touch with his fellow-men. But, as the human mind has its 'likes' and its 'dislikes,' its loves and its hates, it stands to reason, that as no man can get on alone, a person will keep up his connection with those that take his fancy and disregard the rest. Those that keep up a connection, naturally mutually desire to help each other, and only in organised coöperation can help be efficiently proffered. Therefore, although perhaps living widely apart, there will ever be organisation. This organisation is therefore also, in a wider sense, a community; and a community requires a head. Confucius' words will be as true of the future and as adaptable as they were in his day, however widely dispersed the members of a community may be:—

> "There can be no properly constituted community without government, no government without subordination, and no subordination without a dominant authority."

To guide a community, the man with brains is wanted. Sagely say the Hindus:—

> "All the cows bring forth are cattle—only now and then is born
> An authentic lord of pastures, with his shoulder-scratching horn."[1]

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[1] Sir Edwin Arnold, p. 262.

Not every one is made to rule. In a communistic society, each person would have to work physically, and this would result in poorer mental capacity. The best proof hereof is that, whereas in England and even in Germany, where there is far more state-regulated instruction, those who work mentally give all their time to study, with the result that a very high standard of learning is maintained; whilst in American colleges, where waiters, bicycle agents, farm-labourers, and shoe-blacks side by side with Plutus' sons fill Minerva's halls, deep erudition, finish, and precision are eminently wanting; and this despite the fact that the latter are not handicapped, as are the English, with Greek and Latin or mathematics or some branch of learning,[1] but are at liberty, according to their 'elective' system, to choose their subjects. In fact, in the very freedom of their choice is to be found another cause for deficiency. An experienced head is wanting to guide the novice. A sphere is a sphere from whichever side you look at it, and the roundabout away expressed,

> "Of the Tree of State the root
> Kings are . . . feed what brings the fruit."[2]

The head requires a neck to support it, the neck relies on the trunk, whilst the trunk rests on the limbs, and the whole stands on the ground. One part—the neck—must be nearest to the head. There must be some members of the kingdom who are more in touch with their majesty than others, these have others under or to support them, and the entire is based on the solid foundation of the constitution of the realm. Being in direct connection, they necessarily, both from above and below, receive remuneration, and thus amass wealth. This must be expended extravagantly and not in moderation or else the wealth is pent up and does no good. Extremes are found everywhere in nature. The sun does good by virtue of its excessive heat.

> "Simple lives mean low earnings, and a low earning nation goes into the market as a borrower under a handicap."

The luxuries in which wealth indulges are naturally bought from friends, who therefore likewise are abundantly enriched. Thus a caste of capitalists is evolved. Had these capitalists no chance of spending their hoards, they would soon be able to oppress the less rich, and opulence of the few would denote servitude of the masses.

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[1] *Vide* Eustace Miles in the "Daily Mail" for August 16th, 1906.

[2] Sir Edwin Arnold, p. 266.

It may be urged that the rich have in the many arts and sciences, outlets enough for their superfluous means. It has, however, been my experience that every effort that man has made, every ideal to which he has striven, has had its origin in woman; it is the old case of *cherchez la femme*, and with the emancipation of woman it will be *cherchez l'homme*. Take away woman from man and there were no or very inefficient incentive nor any adequate means of disembursement. To prevent this lock of capital therefore, nature provides a valve: indiscriminate intersexual concourse. Each person seeks to look his or her best. They bedeck, bedizen, and adorn. They cultivate the arts in order to beautify their surroundings, knowing that a good jewel should be well set—and all this as an enticement to the opposite sex. They seek to be as lively and as interesting as they can, and to this end entertain, eat, drink, and make merry. One and all are happy—those entertaining, for they have their heart's desires, those who have to provide the entertainment, for money has circulated. Sexual intercourse has been the indirect means of raising the mental and moral niveau and of maintaining a balance not between rich and poor, but between richer and poorer.

All the statistical returns both in England and abroad go to show that there are less poor than there were. There is a greater distribution of wealth. In Germany, for instance, this has been judged by the increased number of those who pay the income tax—every person there with an income, derived from earnings or elsewise, of over £12, or thereabouts, per annum, being taxed. This augmentation is to a great extent due to an increased commingling of the classes, as evinced in the steady growth of parliaments and popular representation, in the construction of the republics of France, Switzerland, and of North and South America, and in the presence of the lower classes not only in town councils, but in the state palava. True it is, that ancient history and the English Cromwellian Commonwealth also provide us with examples of republics, but they were forerunners, caused by revolution, and of no permanent character, whereas the others have probably come for a long stay, the American ones being from the very beginning what they now are.

Intermarriage between those of different social status is now also of far more frequent occurrence, and forcibly reminds me that

"the males and females of the same species of butterfly are known

in several cases to inhabit different stations, the former commonly basking in the sunshine, the latter haunting gloomy forests." [1]

It is well that so is the tendency, for if intelligence be sinking, people will not have so high a capacity for self-help as they had.

But, dear readers, to repeat: do not break your heads about to-morrow. Think of to-day and let to-morrow take care of itself.

"Whatsoever thy hand findeth to do, do (it) with thy might, for (there is) no work, no device, nor knowledge, nor wisdom, in the grave, whither thou goest." [2]

Comp. St. Matthew VI 33 – 34

Do not however overdo aught.

"I returned, and saw under the sun, that the race (is) not to the swift, nor the battle to the strong, neither yet bread to the wise, nor yet riches to men of understanding, nor yet favour to men of skill; but time and chance happeneth to them all." [3]

Nothing will come about nor happen till it is necessary, and when it is necessary it will be there.

"So all things have their supreme moment; so electricity slept in the amber and was known to the Greek 600 years before Christ, but was only wedded to applied science in the laboratory of the nineteenty century." [4]

"When a man appears before his time he has to stand down, and another takes up his message later on." [5]

Take things coolly and quietly and with due deliberation. You cannot hurry things up, and everything follows its natural order.

"Shoot a hundred shafts, the quarry lives and flies—not due to death;
When his hour is come, a grass-blade hath a point to stop his breath." [6]

"That which will not be, will not be—and what is to be, will be:
Why not drink this easy physic, antidote of misery?" [7]

"Be not righteous over much, neither make thyself overwise: why shouldest thou make thyself unhappy?

"Be not over much wicked, neither be thou foolish, why shouldest thou die before thy time?" [8]

"For the living know that they shall die: but the dead know not anything, neither have they any more a reward; for the memory of them is forgotten.

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[1] Darwin's "Descent of Man," ch. i., p. 391.
[2] Eccles. ix. 10.
[3] Eccles. x. 11.
[4] Rev. H. R. Haweis, p. 143.
[5] Rev. H. R. Haweis, p. 145.
[6] Sir Edwin Arnold, p. 246.
[7] Sir Edwin Arnold, p. 227.
[8] Eccles. vii. 16-17.

> "Also their love, and their hatred, and their envy, is now perished; neither have they any more a portion for ever in any (thing) that is done under the sun.
>
> "Go thy way, eat thy bread with joy, and drink thy wine with a merry heart."[1]

It is not wicked to make the best of life and to partake of all that is, for all that is, is necessary. To make merry and to drink wine is no sin. Only over-indulgence is sin, and just as much a sin is total abstinence, which is a puritanical desire to browbeat nature.

The historian, Dr. Amiel Reich, rightly argues that teetotal nations go to the wall, whilst moderate drinking ones survive.

> "All the great nations of antiquity and of modern times—the Greeks, Romans, French, English—have been moderate drinkers; that is, as nations; each nation had, of course, its exceptions, the few who totally abstained. The Greeks, the wisest of all nations, prefer moderate drinking even to moderate eating, and, save the Spartans, who abstained, all Greece drank in moderation. On the other hand, look at the record of two great nations which were practically teetotallers, yet not entirely so—the Mohammedans and the Spaniards of Europe. It is a fact that the Mohammedans are lower in the scale of civilisation; and the Spaniards to-day are not among the first nations of Europe. . . . . Now as to statistics, how can any teetotaller account for the fact that of all the nations of Europe, the French have the best chance of longevity after the age of forty-five, although not one per cent. are total abstainers? No Frenchman, so far as I ever heard, ever touches wayer neat. The same thing can be said, to a great extent, of the Germans."[2]

The reason that teetotalism has not done life and character and brain more harm than it has, is to be found in the fact that superior brains saved its adherents in spite of themselves. They partook of alcohol without knowing it. [illegible] It is a funny statistical fact that of 924 samples of ginger beer, lemonade, herb beer, and similar concoctions which were analysed in the laboratories of the British Government in the year 1905-6 (March 31 to March 31),

> "349 contained over 2 per cent. of proof spirit; some of them as much as 9·5 per cent. That teetotalism (so-called) is making headway under such comforting 'temperance drinks' does not surprise me."[3]

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[1] Eccles. ix. 5-7.

[2] *Vide* the "Daily Mail" for Aug. 25th, 1906.

[3] "Daily Mail" for Aug. 27th, 1906.

Alcoholic beverages are undoubtedly there to be drunk, to strengthen and re-invigorate the sick and to cheer up those who are unhappy. This is propounded and set forth in the Old and New Testament.

> "It is not for kings, O Lemuel, not for kings to drink wine; . . . .
>
> "Give strong drink unto him that is nigh perishing, and wine unto those who are bitter of spirit (of heavy hearts)."[1]

And Paul's maxim to the aged Timothy was,

> "Take a little wine for thy stomach's sake."

Was it not Pope Benedict XII. who said "*Bibamus papaliter*"? Was Joseph Chamberlain a sinner when he said, "Drink imperially"? Oh, no. Strengthen yourself, cheer yourself, and replenish the exchequer.

The code of morality herein laid down need not startle you. You say you dare not adopt it, however welcome it may be, for —'what would the world say?'

Accept not the rôle of playing the rope-dancer, funambulating on public opinion, for, being emotional, its oscillations are far too great to be risked, and it is an exhibition of a weak personality to be forced constantly to alter your centre of gravity to another's whim;[2] but prefer rather to walk straightforwardly and surely on the terra-firma of common sense. Others will soon follow suit; but do not wait for, nor trouble about, these others. The fiat has gone forth ***to be*** free, ***not to make*** one's self or others free. The latter belongs too much to the future. Live out your lives anacreontic and in peace, unheeding the tormenting and torturing fulminations of malicious inconsiderates, and shielded by reason from the exciting nerve and brain-destructive etesian winds of religious revival (fanned by a church-friendly press), which is the breath of life of the body ecclesiastic. As the Hindu adage has it:

> "Bakri ki lát ghoosit ták," "A goat can kick only as high as the knee,

and luckily, spiteful people are as impotent as they are malevolent.

* * *

"What new things have you told us? Have you done aught but to string together a series of already known scientific facts?"

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[1] Proverbs xxxi. 4 and 6.

[2] Although it may often denote strength of character to voluntarily change your own opinions (*vide* p. 9).

I reply: "What I have done is but little, yet that little is very important. The facts were there, but they were not in series. The country which you have been shown existed before I showed it you, and so did many of the highroads and paths. But I have made you new by-ways, cut down barriers, and removed obstacles, and taken you to a lofty summit, whence you have obtained a perfectly new and magnificent aspect of the entire—and a wider. Your opinion of the country is quite different to what it was before you saw it in all its veritable beauty. My opponents may tell you, you have been shown a phantasmagoria. I can only do, as I am by the force-forms forced to do. What I have shown and advised you, I have done for the best. Should my aspect appear wrong to many and a deception, remember, that a fight against the lie is not always a fight for the truth. Take heed lest you accept from others with impurer motive, worse than I have given. At all events, I feel that in essaying to show you the truth and the whole truth as I see it, I have done right. Again, and for the last time, I strike the keynote, first played by Dr. Peters (but to how different a tune!): 'what is there is necessary.' This work lies before you—it is necessary,—

'I fear no Vidimus on the last day.'

APPENDIX.

(1)

On page 118, the question was asked, 'Why the atoms of two bodies, each of given characteristics, combine to form a third body with the characteristics of neither of them?' It would be of especial interest to definitely answer this interrogatory with respect to menthol and chloral, which although individually both solids, in combination produce a liquid.

(2)

Since writing pp. 164-166, I have to report the very remarkable but wonderfully successful experiments with sheep that have been carried out by the electrician of telephone fame—Dr. Alexander Graham Bell. After sixteen years' experimenting, carried out under his supervision on his farm at Baddeck, Nova Scotia, and at the Carnegie Institute on Long Island, he has been fortunate to rear from sheep with embryonic nipples other than the usual two, *a distinct permanent variety* of sheep, possessing four live functional nipples, whilst sheep with six healthy milk-yielding nipples are not seldom, and in one case he has reared a ewe with eight nipples. Dr. Bell is seeking in this wise to produce a variety of twin-bearing animals. It were well if English breeders would continue these experiments, and especially with 'Dorset Horn,' which ewe twice a year. This would probably lead to a variety producing four young ones annually.

(3)

With regard to the insufficiency of sexual relief during sleep (*vide* p. 384), be it on medical authority furthermore said, that a man not copulating, requires also much more exercise than one so doing, and this is very often prevented by the nature of his occupation and the

hustle of business life, which necessitates his making use of a vehicle where formerly all could, *per pedes*, with ease have been accomplished. The baneful results are evident. Added to this, increased competition means an enhanced output of mental concentration, and to maintain an even mental balance, greater sexual intercourse is requisite. The wife, not similarly concentring her mental powers, does not require this; and thus the man, not to wear down his wife's health and strength, is morally bound to seek relief elsewhere.

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